April 28, 1893 - H. M. Howe. Boston.

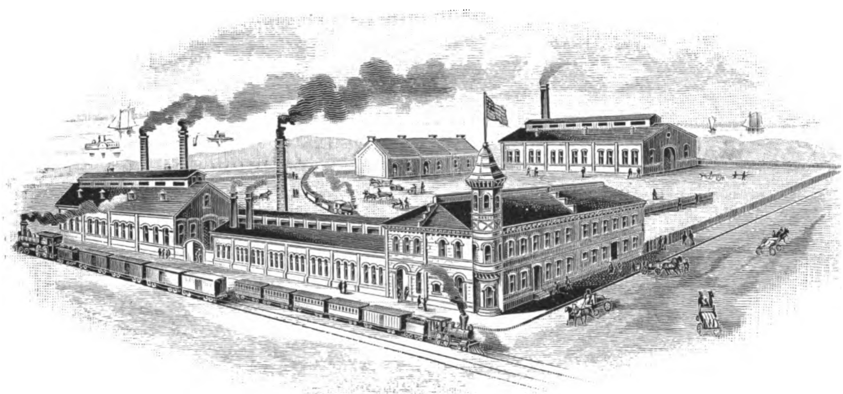
CATALOGUE OF THE MANUFACTURES

• OF •

Philadelphia Engineering Works, Limited

CONTAINING

Convenient Rules, Formulæ for Blast Furnace Management, Equipments for Blast Furnaces, Steel Plants and Iron Works.



WORKS AND MAIN OFFICE

MIFFLIN · STREET · EAST · OF · FRONT

PHILADELPHIA, PA., U. S. A.

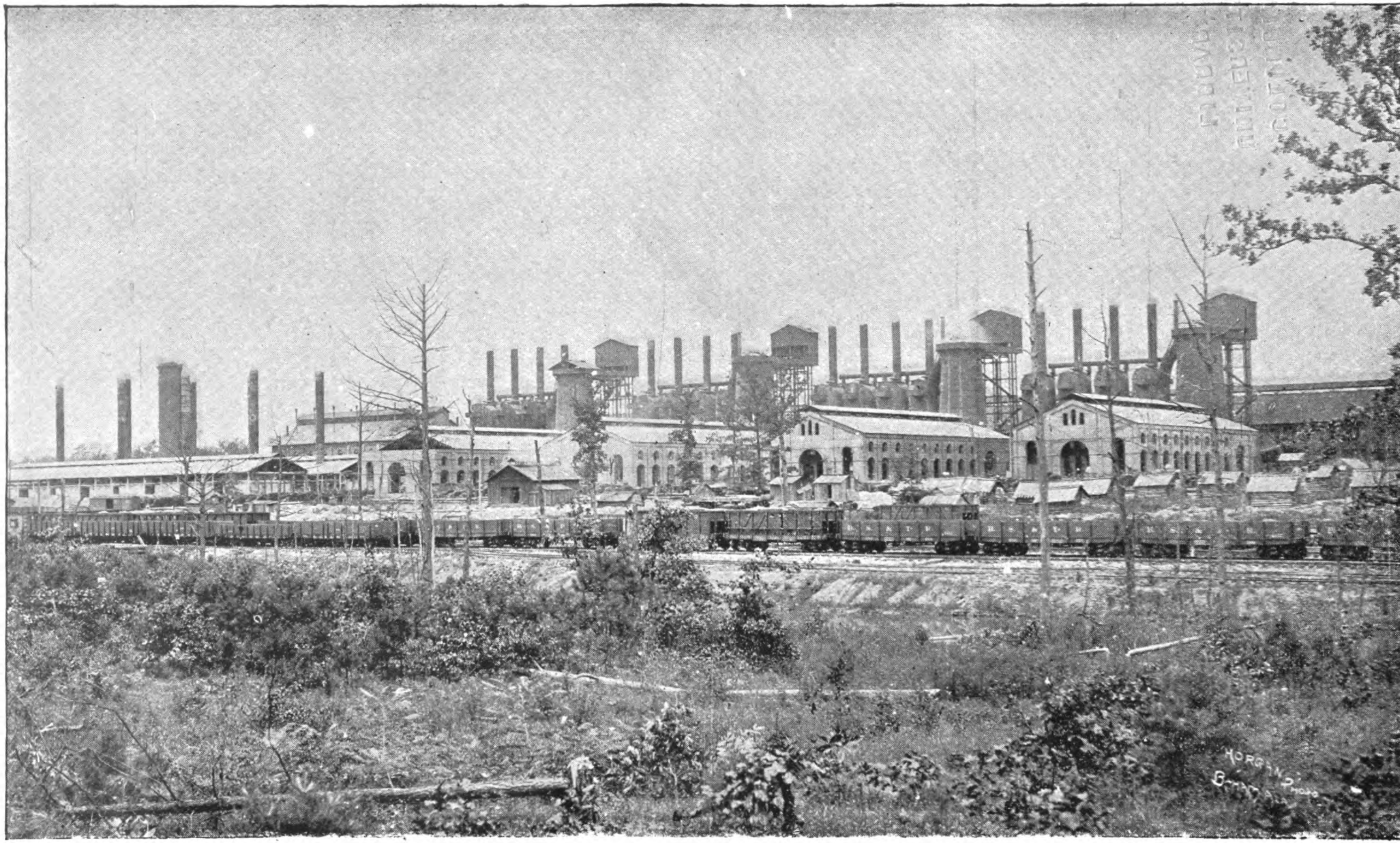
CABLE ADDRESS: GORBEL.

WESTERN OFFICE

Phœnix Building, Chicago, Ill., U. S. A.

JANUARY, 1893

FIG. 1.



WORKS OF THE TENNESSEE COAL, IRON AND RAILROAD CO., ENSLEY, ALABAMA.

GORDON, STROBEL & LAUREAU, ENGINEERS.

INTRODUCTORY

WE take pleasure in presenting this catalogue to our patrons. It will be found a convenient and ready hand-book to furnacemen in determining the relative costs of raw material used in the blast furnace, the quantity of carbon to be burned for the production of a ton of iron with certain ores, the quantity of limestone to be used and other tables and data wanted for every-day use.

The engravings illustrate in detail such appurtenances manufactured by us which will enable furnacemen to adopt the latest and most approved construction of parts.

As our experience covers a period of twenty years, we have carefully and closely followed the construction of iron and steel works, perfecting detail and introducing such changes in designs thought most beneficial to our patrons. In every instance the information we give is such as experience has demonstrated to be of service to those contemplating the erection of new work or those modifying or remodelling existing plants. We respectfully ask any one contemplating the erection of new work to write to or confer with any of the companies named in the lists for whom we have executed work.

Our works have been gradually enlarged, new and improved tools added from year to year, enabling us to do work accurately and thoroughly satisfactorily. We have a full and complete line of patterns of such work as is herein specified and shall be pleased to submit prices and specifications upon application.

The right is reserved by us to make such improvements in details and thereby vary in some degree from the description and illustrations herein as may be beneficial, without violating the spirit of the agreement, to furnish as per specifications.

PHILA. ENGINEERING WORKS, LIMITED.

Philadelphia, Pa., 1893.

INDEX.

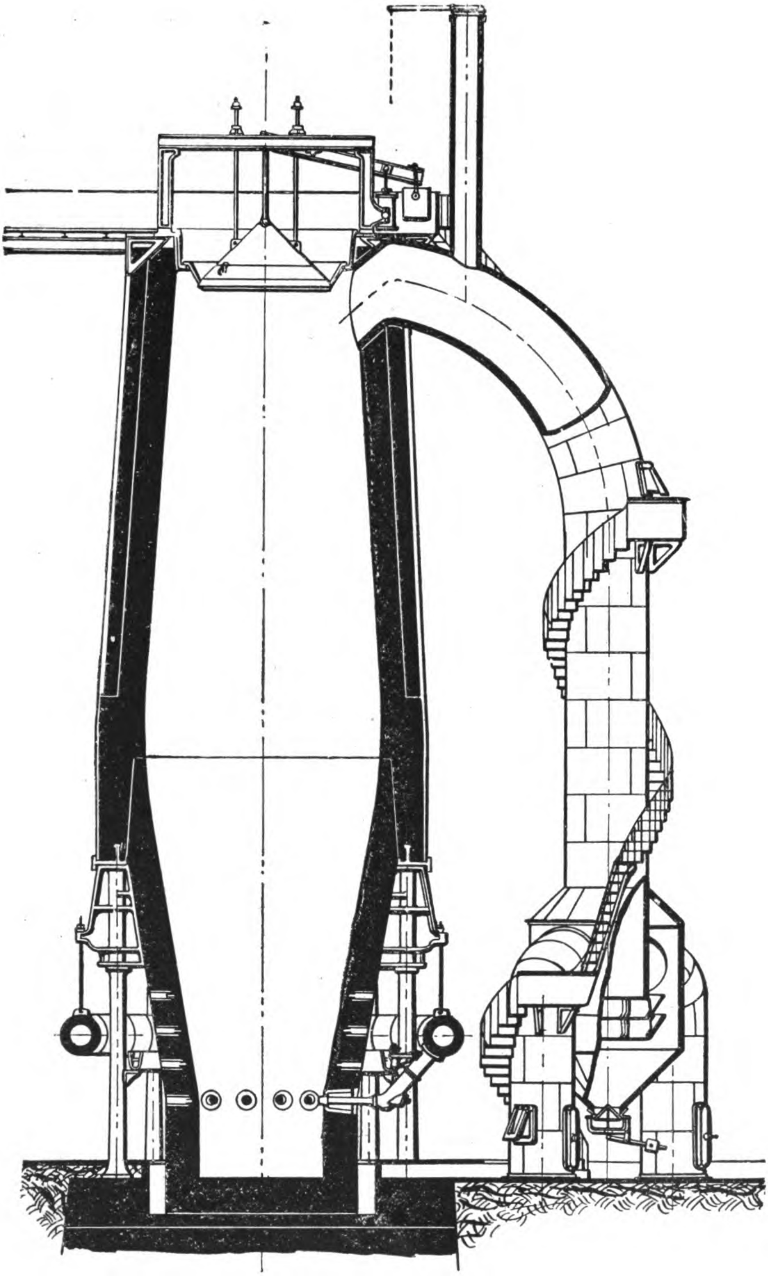


FIG. 2.—BLAST FURNACE.

Blast Furnace.

WE illustrate, on opposite page, a type Blast Furnace designed for coke or anthracite practice. The columns are made of cast iron, fitted at the bottom to a heavy cast-iron foundation plate and at the top to a mantle plate. The mantle plates may be made of cast iron, with heavy webs and flanges, or of eye and channel beams, bent to a circle, and stiffened with separator castings.

The bosh brickwork may be held in place by a series of crinoline bands and buckstaves, or with a heavy jacket made of plate iron.

In some cases we support the crucible brickwork with a jacket made of heavy plate iron. An annular space is left between the jacket and brickwork, which is filled with broken brick. A water spray pipe is secured to the top of this, part of the water percolating through the annular space and part on the outer surface of the jacket. The dam plate is a heavy casting bolted to this jacket, and may be coursed with water pipes or left dry. The jackets are made in three pieces, being connected with bolts and nuts, working in slotted holes to allow for expansion.

Crucible jackets are also made of pipe coiled segmental castings, extending around the hearth, and strongly fastened together with key bolts.

Bosh walls may be cooled with either hollow bronze or pipe coiled castings. These plates are made in segments and built in the walls, or the entire bosh may be cooled with a series of pipe coils placed between the brickwork and bosh jacket.

The tuyere stocks are made of cast iron, lined with fire-brick, as described on page 62. The tuyere arches and bosh plates are supplied with water from a cast-iron pipe extending around the bosh walls.

The discharge, or waste water, is conveyed to a circular trough, extending entirely around the furnace columns, and located at a point where each and every discharge pipe can readily be seen.

The furnace casings are made of heavy plate iron, varying in thickness for different diameters. All horizontal seams are single riveted, and vertical, double riveted.

The Bell & Hopper mechanism, explained on pages 60 and 61, is supported upon cast-iron brackets, riveted to the furnace casings.

The down-comer is made of plate iron, and extends to the ground level. At the bottom a dust catcher is attached, provided with an explosion and cleaning bell. A wrought-iron stairway is secured to this down-comer, by means of which the explosion and cleaning doors and furnace top may be reached, in case the hoisting engine or furnace should be stopped. The entire casings are lined with fire-brick, the hearth and bosh brickwork being laid with No. 1 quality brick, the inwall with a No. 2 quality and the inwall backing with a No. 3 quality of brick.

We will make propositions for the erection of ironwork, or ironwork and brickwork, complete, for furnaces of any size and capacity, upon application.

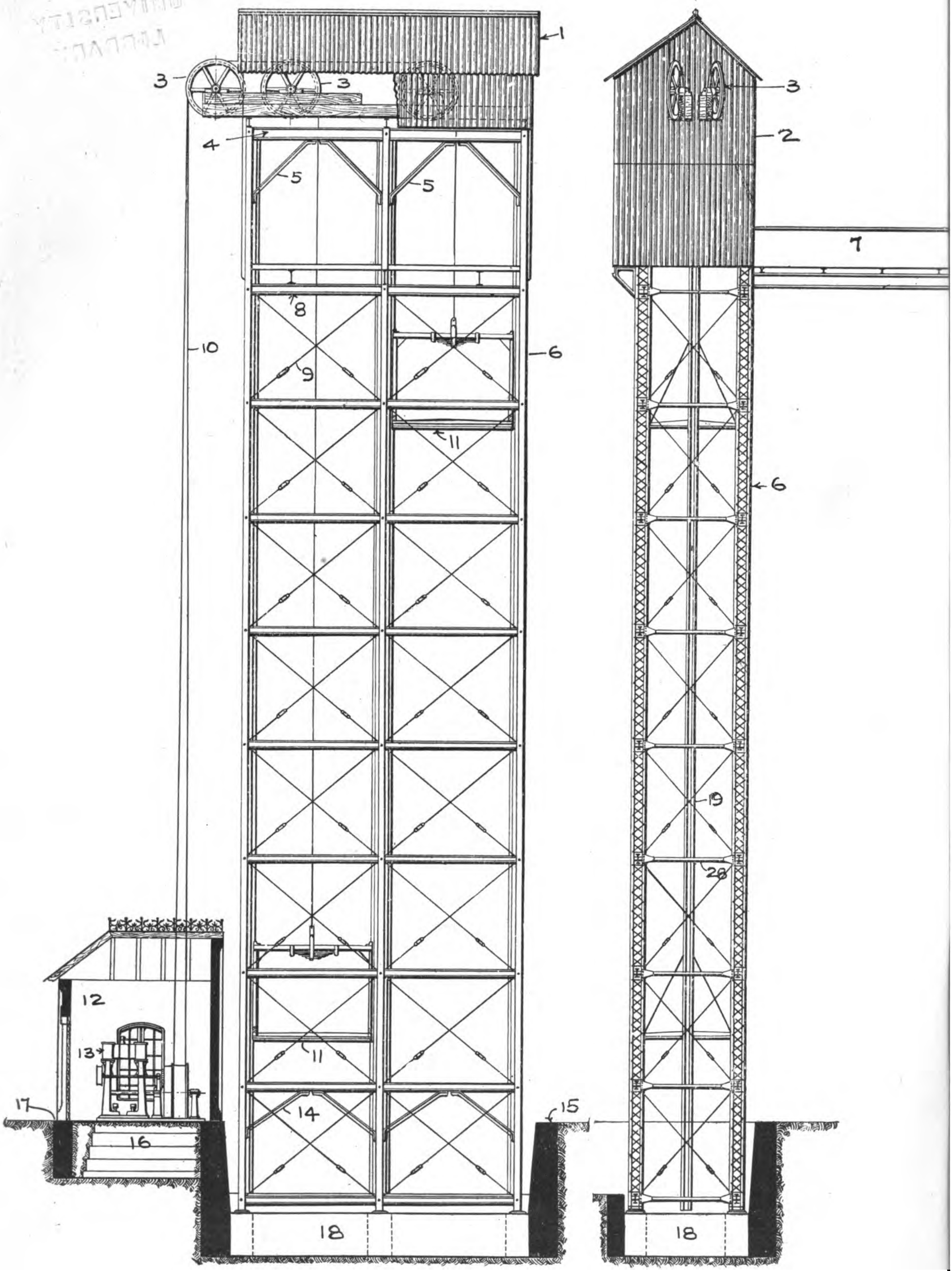


FIG. 3. HOIST TOWER. FIG. 4.

Wrought Iron Hoist Towers.

THE engravings on page 8 illustrate Wrought Iron Hoist Towers designed for two cages or platforms. The columns (six in number) are made of eye beams, channel beams or angles, properly latticed. The struts (*28*) are placed at intervals of about eleven feet. The panels are braced with diagonal tie rods (*9*), each being provided with a turnbuckle, by means of which the whole tower may be brought into alignment. A balcony is erected at the platform level to the back row of columns, upon which the cage operators can stand when raising or lowering loads or charging the furnace. This balcony and the top panel of the tower is enclosed by a building and roof, sided and covered with corrugated iron.

The cages are made of seasoned hard wood, secured by iron bracing, and are provided with safety catches and pawls. They are guided in the tower by strips of wood (*19*) securely bolted to struts (*28*).

The sheaves (*3*) work in bearings secured to timbers bolted to the top of the tower, and are enclosed by the roof.

The hoisting engines (*13*) are of the double automatic type, and are placed in a brick building (*12*) located on one side of the tower.

We build these towers for any lift and size of cages, and shall be pleased to quote prices upon application.

State size cage wanted, total lift and load to be lifted.

Boilers for Blast Furnaces.

THE engravings on page 11 illustrate the two-flue type of boiler setting generally used for Blast Furnaces. The boilers vary in length from twenty-four feet to thirty-four feet, and in diameter from forty-two to seventy-two inches, each boiler being provided with two flues. As will be seen in the cut, the gas for combustion is introduced by our patented gas burners *14*, described on page 113, into a long combustion chamber *15*, the products of combustion hugging the shell of the boilers and returning through the two flues into a breeching pipe and chimney. A single breeching and chimney can be used for a series of batteries, or an independent breeching and chimney for each battery, whichever plan may be found most advantageous.

The shells *1* are made of soft steel, all horizontal seams being double-riveted and the circumferential seams single-riveted, lapping in the direction of the flame. Each battery of boilers (which may be composed of a nest of two, three, or four) is provided with an independent steam and mud drum *4* and *5*.

Cast iron cleaning doors *13* are disposed in the side and end walls, through which the accumulating dust, etc., may be removed.

Each battery is suspended at two points, the front end resting upon a cast iron fire front and the back end upon two I beams *12*, supported on independent cast iron columns.

The brick walls are bound together with wrought iron binders held in position by buckstaves made of channel iron, secured top and bottom by means of tie bolts.

We have a full line of patterns of fire fronts, binders, doors, etc., for boilers, ranging from forty-two to seventy-two inches diameter, and shall be pleased to quote prices upon application, for the whole setting or any part thereof.

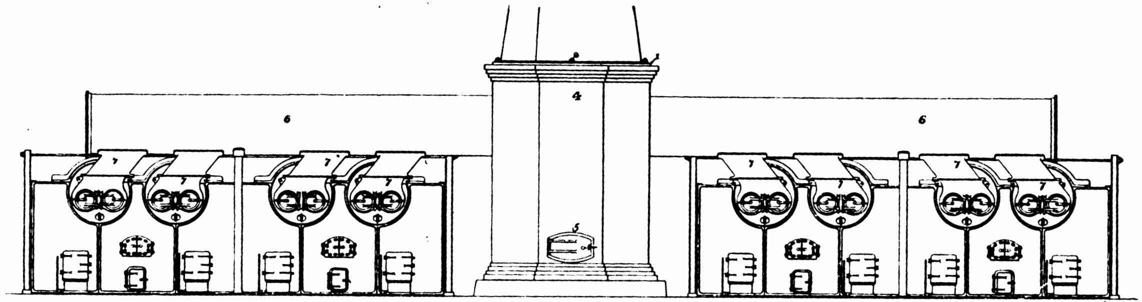


FIG. 4.

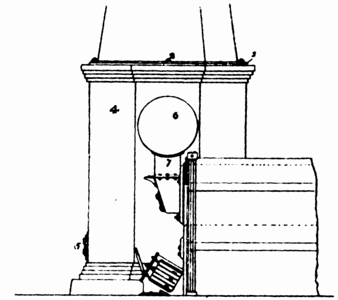


FIG. 5.

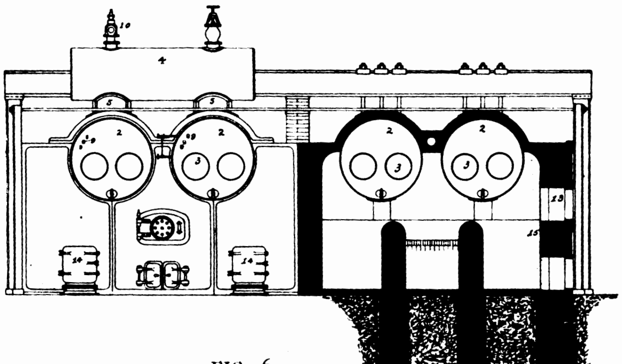


FIG. 6.

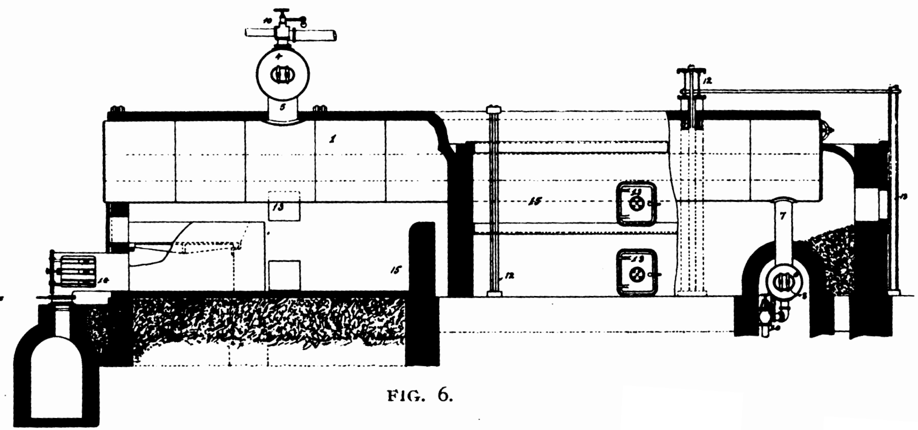


FIG. 6.

Fire-Brick Hot-Blast Stoves.

116 IN USE January, 1892.

THE first three-pass stove had the combustion chamber on the side, from which the gases flowed in a right line across the stove, entering the down pass on top, and from it entering the chimney pass at the bottom, and then through the chimney pass directly out of the chimney. This was the simplest possible construction, and left nothing to be wished for in the way of efficiency, except that the first stoves were made with fine checker work in the last pass, which by carelessness clogged, checking the draft, and thereby limiting the amount of gas that could be consumed.

The plan had, however, two structural defects. One was the introduction of the blast into the chamber under the chimney above the third pass checker work. A powerful blast blew out the clay in which the bricks were laid and weakened the division wall above the checker work between the second and third passes. The bricks forming the top course of the chimney pass checker work were also displaced in the same manner. By introducing the blast into the bottom of the chimney just below the chimney valve all these difficulties were overcome. The blast then descended directly on top of the checker work, and, not striking any of the walls, did not blow out the clay. This defect has been very common in fire-brick stoves, and would not have been particularly noticed in either the Whitwell or Cowper, but in any new type all the difficulties are well heralded.

The second structural weakness was the large top arch which spanned the entire stove from side to side, the span of the arch being practically the same as the diameter of the stove. It was found that this arch gave way under heavy duties. The span was too great, and changes of temperature from gas to blast had too much effect upon it. It did not give way entirely, but bricks fell out. These bricks were made to interlock, and therefore broke away without the arch tumbling in. No attempt was made to overcome this defect while the circular iron top construction was adhered to, and it remained for the complete remodelling of the stove, as shown in *Fig.* 7, to overcome it, and to secure a substantial construction throughout.

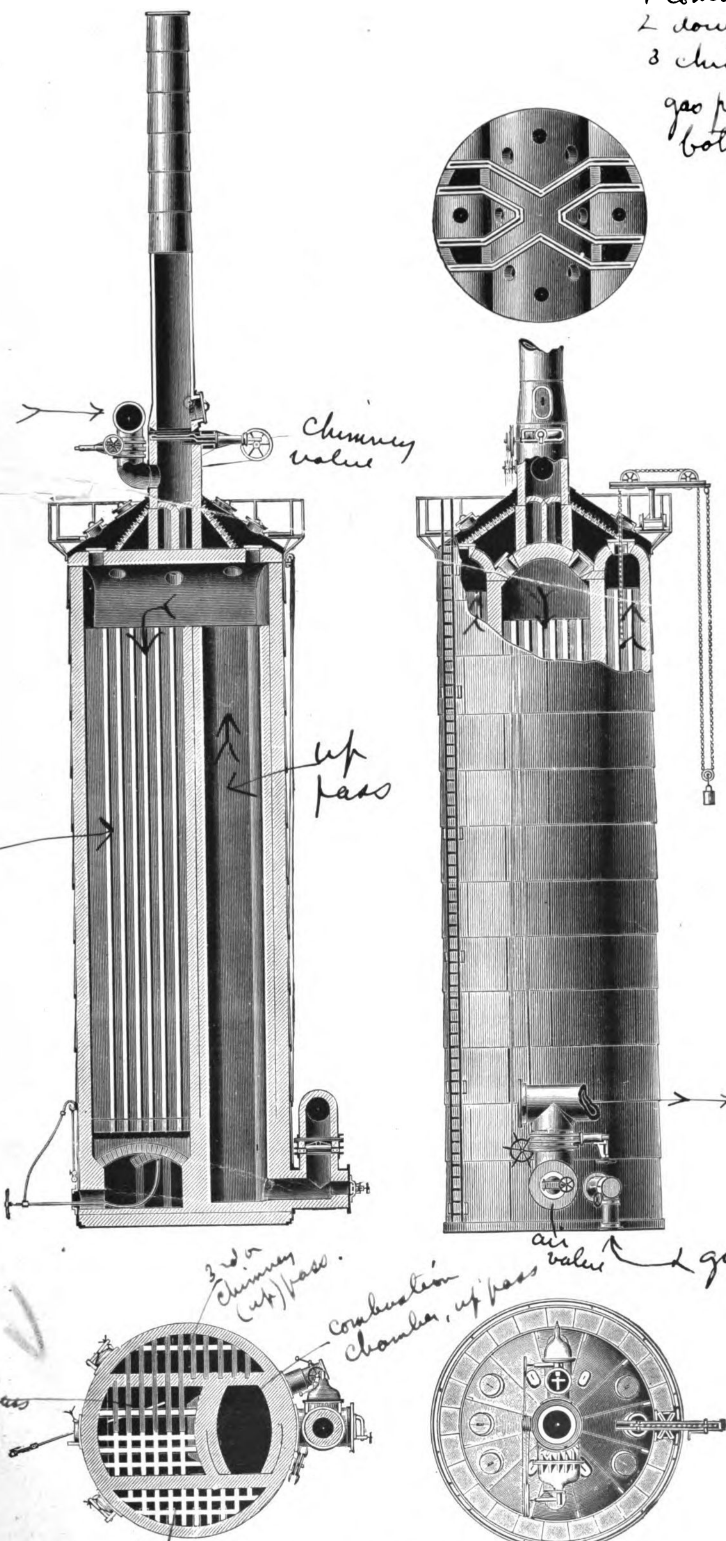


FIG. 7.—HOT-BLAST STOVE.

The arch now spanning the combustion chamber and covering the first down pass has a span of just half the diameter of the stove, under which there is ample play for the gases, giving every opportunity for a utilization of all the checker work of the down pass. On top of this substantial short-span arch are built the flues to convey the gases from the top of the chimney pass to the chimney and the bottom brickwork of the chimney proper. This work increases the stability of the arch and places between it and the iron shell sufficient material to prevent the latter from being injuriously heated at any time, no matter how strongly the stoves are worked.

This arch cannot provide an opening for the passage of the gases directly to the chimney. To reach the chimney the gases must pass down to the bottom and up the chimney pass. The gases from the combustion chamber enter the down pass, and having passed through it, enter through large arches into the chamber beneath the two symmetrical passes, forming a chimney pass, and rising through them give off their remaining heat to the checker work, and are received on top into chambers above the checker work. From each of these segmental passes there are two flues or passages, making four in all, leading to the base of the chimney. The side combustion chamber has been adhered to. It is theoretically true that if the highest heats be confined to the centre of the stove there will be less loss by radiation, but this loss is not appreciable, while the side combustion chamber can be cleaned more readily and a better diffusion of gas and larger heating surface obtained. The first stoves ever constructed by Mr. Cowper had the central combustion chamber, the gases descending all around it. This type was then abandoned and never revived until quite recently.

The checker work in all cases has four-and-one-half-inch walls and nine-inch openings, which are either square or circular. The circular flue is preferred by some, as it is thought that a round flue will not collect dirt as rapidly as a square one. This plan provides about the same amount of brick to the area of the pass, and gives about the same area for the passage of the gases or air. The cost of constructing the brick is about the same with either type, but it has not been demonstrated that the round has any particular advantages over the square opening. Experience has proven that a nine-inch opening is the most desirable throughout a stove. The stove keeps clean for a reasonable time without attention ; excessive friction is avoided, while a fair amount of heating surface is secured. Flues larger than nine-inch impair the heating surface while increasing the capacity to burn the gases. There may then be too much fuel burned for the amount of surface to absorb the heat in the time allotted, and frequent changes will be required, or an objectionable fall in the blast temperature experienced.

The system of cleaning by blowing steam directly with the current of the gases, from the bottom upward, has enabled the three-pass stove to be

efficiently employed for a period of three and one-half years without once stopping for cleaning or repairs, and then with only three-quarters of an hour's attention every week, and without stopping the stove for an instant. Besides, there is a top-cleaning device, consisting of weighted scrapers operated by chain wheels, on a carriage tracking around the stoves, so the cleaning may be effected through any door with equal facility.

The efficiency of the draft must be measured at the bottom of the combustion chamber, where the gas and air enter, and when the stove is doing the full duty for which it is designed. To insert a manometer in the draft stack is to measure the power provided for the work without determining the power required. To measure the draft in the combustion chamber, measures what power is left after all the work is done. It is a fact that ordinary detached chimney stoves of the two or four-pass type have a pressure of gas within the stove on top when they are doing their full duty, the chimney power being more than exhausted in pulling the gases down the down pass and through the valves and flues leading to the chimney. Their draft is due entirely to rarefaction of the gases in the combustion chamber, less this excess of pressure. Hence, the three-pass stove, with an outlet on top, gains by a simple hole more than all the power of draft which the two or four-pass stove can possibly have.

The draft has everything to do with the capacity of the stove, as its power is a measure of the quantity of fuel that can be consumed in the stove in a given time, and that is a measure of the quantity of heat provided.

One of ~~the twenty-foot three-pass stoves consumes the entire gas coming~~ from a coke or anthracite furnace when making 100 tons of iron per day. Two will, therefore, heat the blast for a product of 150 tons of iron per day to a temperature of 1,400 to 1,500 degrees. In ordinary practice, about one-third of the gas coming from a furnace is used for heating the blast The objection heretofore raised, that a stove could not be heated as rapidly as cooled, is removed. The objection to two fire-brick stoves, on the assumption that one may give way, and by its failure stop the furnace, is not well taken where economy of construction is a prime consideration. There is no part of a furnace plant less liable to give trouble than the modern three-pass fire-brick stove, and it can be cleaned while in use. The brickwork is massive. The brick wall between the shell and the combustion chamber is twenty-two and one-half inches thick. The shell never gets so hot that the hand cannot be placed upon it and held there. The cross division walls are made thirteen and one-half inches thick. The arches are eighteen and one-half inches, and the bottom brickwork is formed of massive piers and walls, sufficient to withstand a height of 150 feet.

The valves have been revised, remodeled and improved after fifteen years' experience. The chimney valve, *Fig. 8*, is just the same as it has

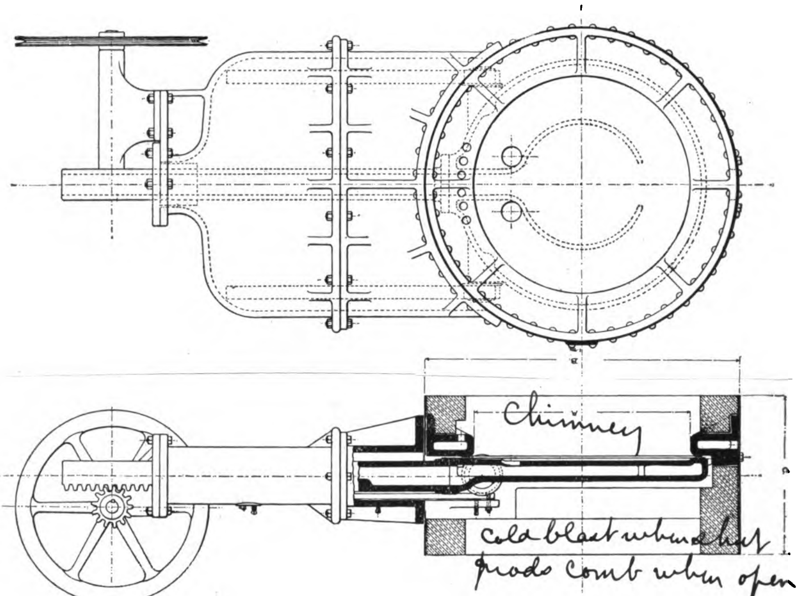


FIG. 8.—CHIMNEY VALVE.

When gases are passing, valve is out of way & hence cool
" wind is " " " cooled by wind " "

Water cooled

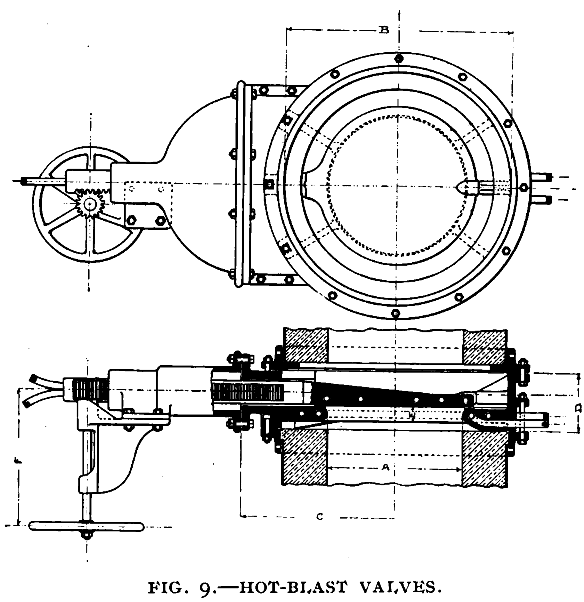


FIG. 9.—HOT-BLAST VALVES.

been for the last seven years. The efficiency with which its valve and seat are cooled by the incoming currents of air, induced by draft, renders it thoroughly durable. Its simple construction precludes liability to disarrangement, and as it is withdrawn entirely from the currents of the gases when it is opened, it neither impedes these currents nor is injured by them. This form is therefore employed in preference to the mushroom or poppet valve, which, though less expensive, so seriously interferes with the chimney currents, ~~while it~~ is exposed to the heat of the waste gases. The cold-blast valve is a simple slide device, seated by gravity. The hot-blast valve, *Fig. 9*, is a water-cooled valve, with a removable seat of cast iron, coursed with lap-welded tubing. This is preferred to bronze castings, as by the stoppage of the water the bronze will crack, whereas the wrought iron pipe, well protected with cast iron, will withstand the highest temperature of blast for a considerable length of time without being injured. The whole valve is of cast iron, and is bolted between machined flanges, which are in turn riveted to the hot-blast pipe. Either the whole valve body, cap and all, can be removed, the cap and the valve removed, or the water-cooled seat removed at pleasure and very promptly, and any portion of these parts can be replaced by duplicates made to templates.

Chimney

Cold blast

Hot blast valve

The air valve, *Fig. 10*, is a flat surface valve, held to its seat by a heavy wrought iron bale. It is not affected by the heat, as it is so far removed from it, being entirely different from the original type of air valves introduced with these stoves. The gas valve, *Figs. 11* and *12*, is a heavy plate operated by double racks and pinions introduced between two cast iron flanges in the gas conduit. It serves as a cut-off or as a regulating valve. The valve, playing between the flanges, is always exposed to view, and can be kept clean without difficulty. Clamp screws either release or tighten this plate to fix it against the pressure of the blast. Its employment is essential, as it precludes the possibility of the ~~gas~~ blast entering the gas mains, which was so common with the older types of gas-inlet valves. Stoves of equal size cost practically the same, whether Cowper,

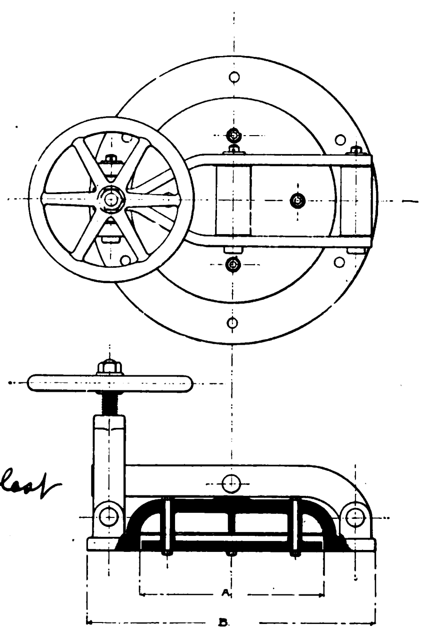


FIG. 10.—AIR VALVE.

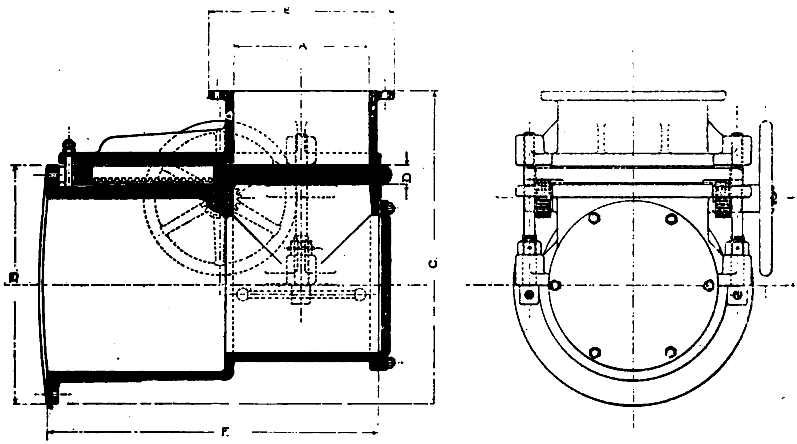


FIG. II.—GAS VALVE FOR OVERHEAD GAS MAIN.

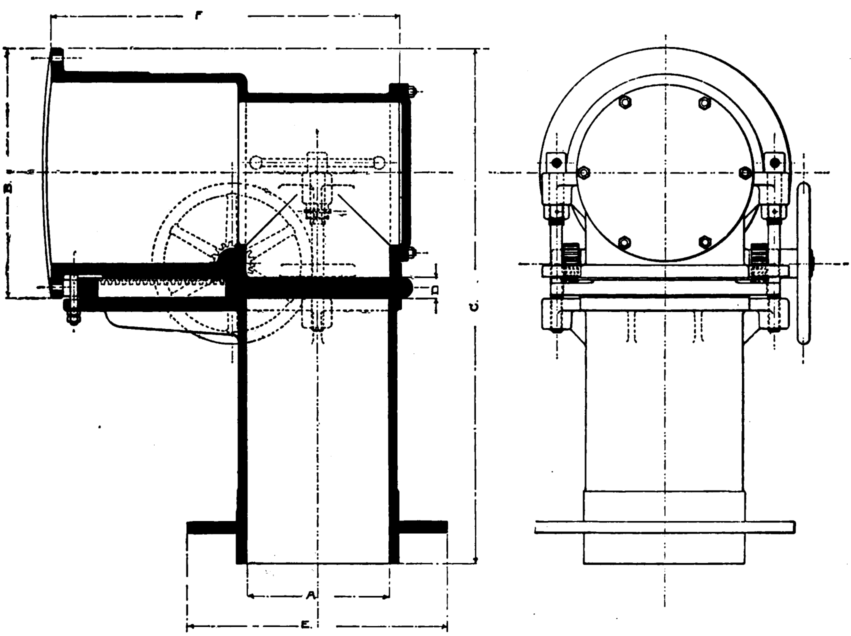


FIG I2.—GAS VALVE FOR UNDERGROUND GAS FLUES.

Whitwell or three-pass, but a plant of either of the two former types requires a chimney, chimney foundations and chimney flues, which, added to the cost of the stoves, enhances the cost far beyond that of a three-pass plant of equal power.

Number of Stoves.	Diameter of Casing.	Height to Base of Chimney.	Cubic Feet of Blast that can be heated to 1,500° F.	Pounds of Coke or Anthracite per 24 Hours.
2	14	60	6,600	123,000
2	15	60	8 200	155,000
2	16	60	9,300	176,000
2	17	60	11,000	209,000
2	18	60	12,500	237,000
2	19	60	14,000	266,000
2	20	60	16,000	304,000
2	21	60	18,000	342,000
2	22	60	20,000	380,000
3	14	60	10.000	190,000
3	15	60	12,000	228,000
3	16	60	14,000	266,000
3	17	60	16,500	314,000
3	18	60	18,500	351,000
3	19	60	21,000	399,000
3	20	60	24,000	456,000
3	21	60	27,000	513,000
3	22	60	30,000	570,000

MANAGEMENT OF FIRE-BRICK STOVES.

Control the flow of the gas by the gas valves at all points of exit, keeping the gas mains always under pressure.

Never open a bleeder valve or other outlet on top of the furnace or other elevated point.

To change a stove from gas to blast:

Close gas valve.

Close chimney valve.

Note that hot air comes out of the air valve. If so, close air valve. If not, see that chimney is fully closed; then—

Close air valve.

Open cold-blast valve slowly.

Open hot-blast valve quickly.

To change from blast to gas:

Close hot-blast valve.

Close cold-blast valve.

Open air valve within bale till air pressure is nearly gone; then throw it wide open.

Open chimney valve fully.

Open gas valve to mark for temperature desired.

We have a full and complete line of patterns for all sizes of stoves, valves and fittings, and shall be pleased to submit prices and specifications upon application.

We have patterns, plans, etc., for all sizes of Whitwell and Cowper fire-brick stoves, and are prepared to quote prices for their erection, when required.

Letters of Reference Concerning Fire-Brick Stoves.

GORDON, STROBEL & LAUREAU, Limited.

Philadelphia, August 25, 1887.

GENTLEMEN: We think the following letter will be of some interest to you, and, as it was written nine months after starting the plant referred to, Mr. Stuart had sufficient data to determine the merits of our stoves.

Very truly yours,

GORDON, STROBEL & LAUREAU, Lt'd.

WESTERN STEEL COMPANY.

GORDON, STROBEL & LAUREAU, *St. Louis, Mo., July 12, 1887.*
Philadelphia.

GENTS: We have been operating your Fire-Brick Hot-Blasts on C' Furnace for the past nine months and beg to state concerning them that they are working admirably. The three stoves, 17' x 65', heat nearly 18,000 feet of air per minute, up to any desired temperature—often to 1,600°, with apparently no injury to themselves; our average temperature is 1,475°. They are very readily cleaned, and can be handled by any intelligent man after one week's instruction. In fact, we cannot see wherein they can be improved upon, and we would not be without them under any circumstances.

There is no trouble in maintaining regularity of burden with them that results in less than 2,000 pounds of coke to one ton of pig iron, and this too not at the expense of quality, as shown by our records for June, 1887; the average silicon for that month being 2.80 per cent.; the average sulphur being .018 per cent. for the same period.

If anyone wants information in detail concerning your stoves or general furnace construction, send them to me.

Yours, etc.,

[SIGNED] C. F. STUART, Secretary.

JOLIET STEEL COMPANY.

GORDON, STROBEL & LAUREAU, *Joliet, Ill., August 26, 1887.*
Philadelphia, Pa.

GENTLEMEN: Replying to yours of the 17th inst., we have three of your Gordon-Whitwell-Cowper Hot-Blast Stoves, 20' x 65', which supply our No. 1 Blast Furnace, of 20 feet bosh and 80 feet height, with a blast at a temperature of from 1,300 to 1,500 degrees.

We have no trouble in maintaining this temperature. The stoves have now been in use for some fifteen months, with but a small outlay for repairs. Yours truly, H. S. SMITH, Gen'l Supt.

F. W. GORDON, ESQ., *Joliet, Ill, February 2, 1889.*
Philadelphia, Pa.

DEAR SIR: Answering yours of the 30th ult., will say we have had three (3) 20' x 65' stoves of the Gordon-Whitwell type in use since

June 15, 1886, and one similar stove in use since September 28, 1886. These stoves are kept in use continually, and heat 21,500 cubic feet of air to an average temperature of 1,300 degrees F., higher heats being attainable when desired. A good deal of dust collects in the large chamber under the checker work, but the passes in the checker work do not get badly clogged, and can be cleaned thoroughly from the inside of the stoves.

We now contemplate putting up four (4) more stoves of this pattern in the near future. Yours truly,

H. S. SMITH, Gen'l Supt.

F. W. GORDON, ESQ., *Joliet, Ill., February 7, 1889.*
Philadelphia, Pa.

DEAR SIR: Regarding yours of the 5th inst., we use three stoves continuously on each furnace; the fourth stove taking the place of any one stove that may be off for repairs or for cleaning, for either furnace.

Yours truly, H. S. SMITH, Gen'l Supt.

BELMONT NAIL COMPANY.

JAS. F. PETERS, ESQ., *Wheeling, W. Va., November 12, 1889.*
Ironton, Ohio.

Replying to yours of the 11th, would say that we never condemned the Gordon Hot-Blast Stove. So far from it we believe it to be the best in the country; certainly it is *second* to none. The valve on top of one of the stoves is out of fix and needs some repairs, but we have never seen the time to stop and make the repairs. Either of these stoves will reach 1,700° when we need it; but we seldom ask more than 1,550 to 1,600°, and that is where they stand every day. Our little furnace makes her 110 to 120 tons per day regularly. The stoves have never been cleaned except by blowing out with steam, and we have not spent a dollar on them, now two years and three months in use. Very truly, etc.,

J. D. DU BOIS.

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116 STOVES IN USE January, 1892.

We have many other testimonial letters which are not published here for want of space.

Variable Cut-Off Blast Furnace Blowing Engine.

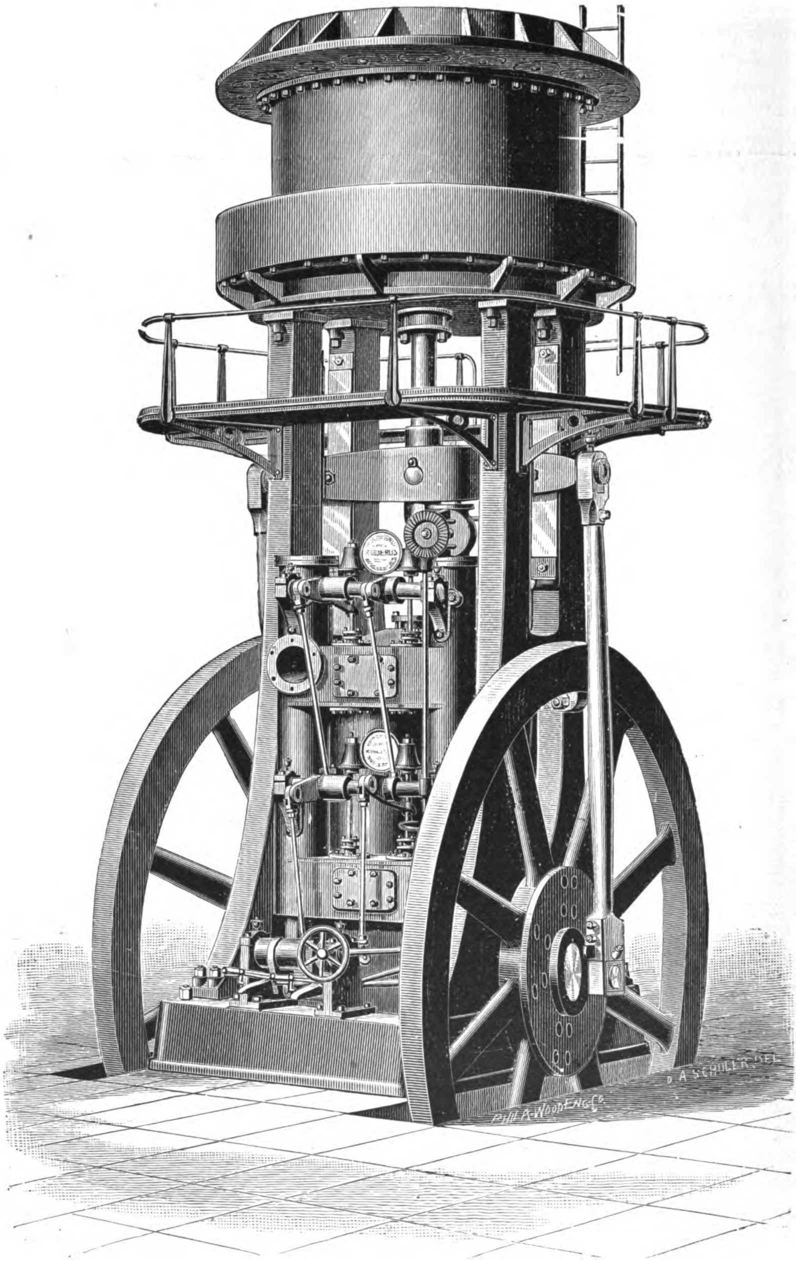


FIG. 13.

Variable Cut-Off Blowing Engine, Governor Regulation.

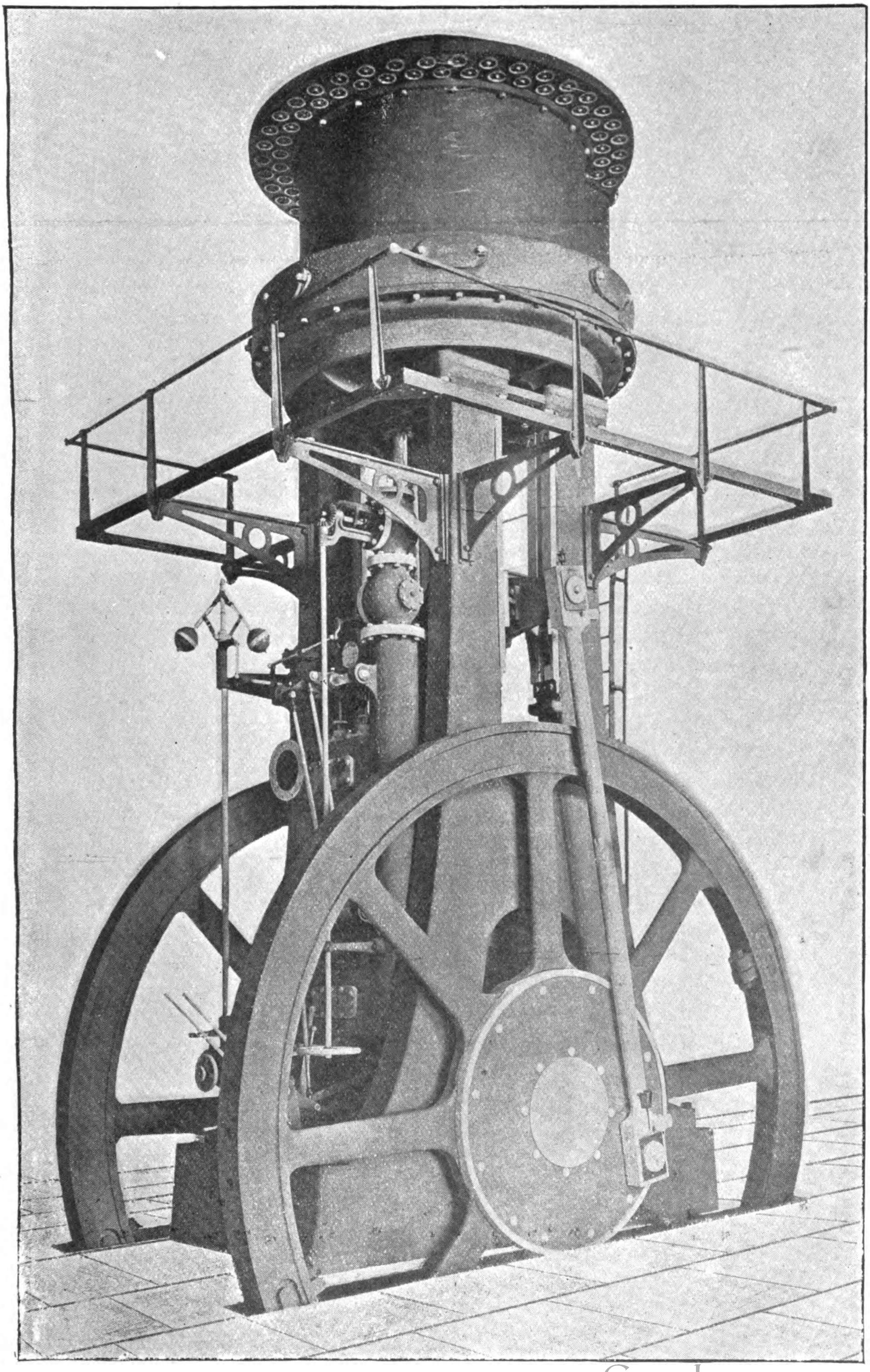


FIG. 14.

WE appreciate that there is no situation where machinery has more constant use and more irregular strains, where there is less time taken for judicious examination, needed adjustment or repairs, than at a blast furnace. The constructor is called upon to produce such as is essentially strong, simple, convenient, durable and effective. Until lately the economy in consumption of steam has not been a matter of much importance, but with the introduction of fire-brick stoves, greatly increased volume of blast and increase in the height of furnace, the fuel consumed within the furnace per unit of work done has been decreased, thus lessening the calorific energy of the waste gases, while the duty required of them has been increased in heating the blast to a higher temperature and in forcing it into the furnace against greater pressures. Increasing the duty and decreasing the heating power of the gas has brought about the common use of coal under the boilers. To avoid this expense, blowing engines of good efficiency must be introduced.

The leading engine of the world is the automatic Corliss. We have applied this to the most approved blowing cylinder arrangement as illustrated on pages 25 and 26. The eight sizes we manufacture are given in our price-list. For details of construction see page 39, etc., where it will be seen that the great weight of metal employed has been carefully utilized to achieve the strongest machine possible.

The Corliss engine requires no advocate. It is too extensively used and well known. Its valve gear, apparently complicated, is the most simple and gives the least trouble. The valves work in almost perfect equilibrium without any balancing mechanism, hence last for many years without any repairs or refitting. The levers, joints and straps which operate these valves are likewise freer from strains and have great durability. The driving mechanism of the governor provides for rapid and extended changes of speed to the engine.

Blast Furnace Blowing Engine with Corliss Automatic Steam Valve Gear.

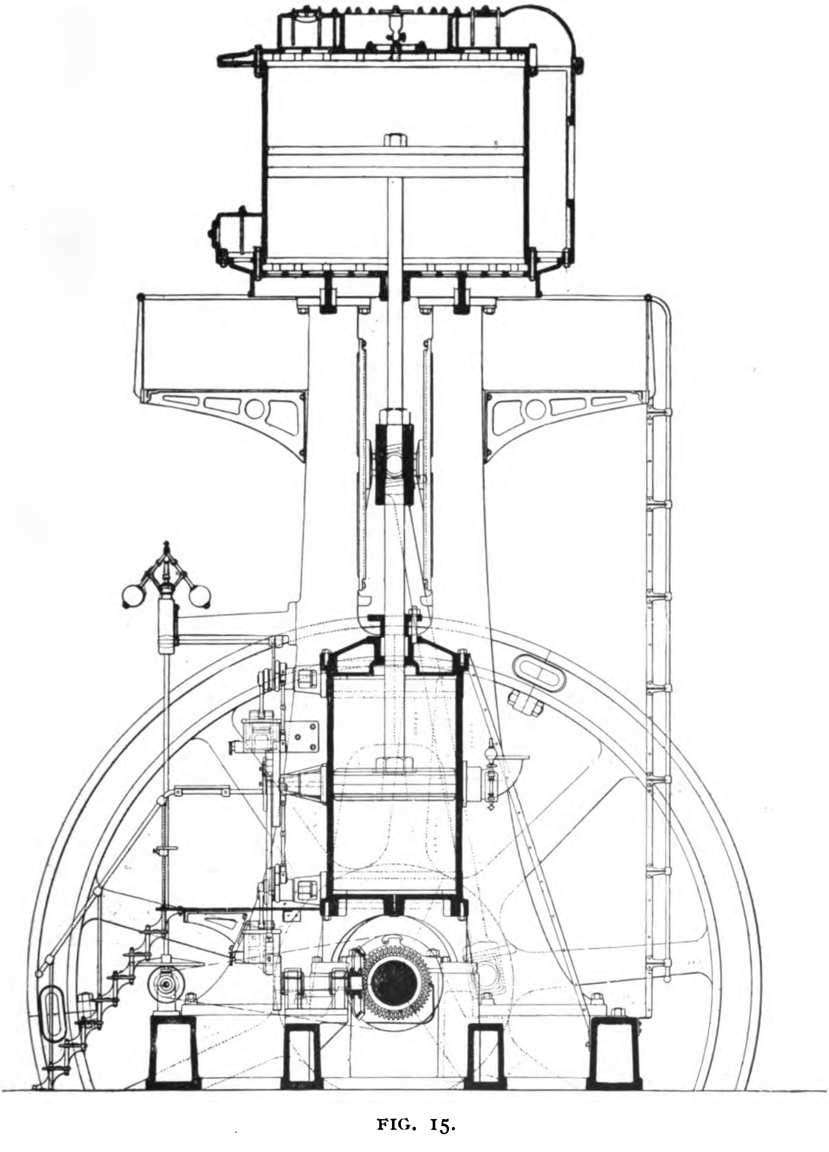


FIG. 15.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

Blast Furnace Blowing Engine with Corliss Automatic Steam Valve Gear.

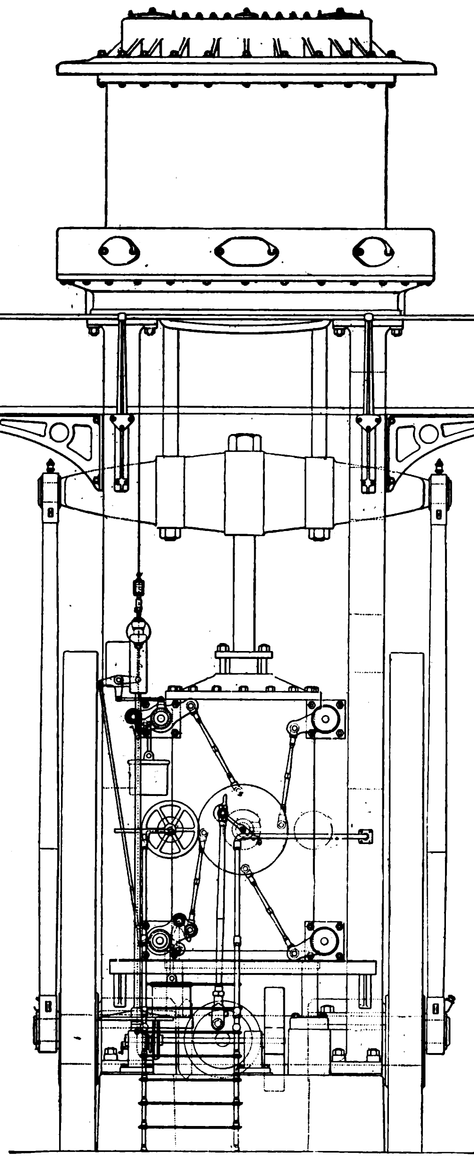


FIG. 16.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

These engines may be used for either condensing or non-condensing. For still higher efficiency the Compound-Corliss Condensing Engine, built in the style of our Duplex Blowing Engine, as shown on pages 33 and 34, is recommended, for which estimates will be furnished on application. This type of engine will be eminently suitable where the furnace plant is so situated that any excess of steam may be carried to the engine of a rolling mill, steel plant, etc. Where the furnace plant is large, and efficient engines are used throughout, all the steam required for the works may be generated by the waste gases of the furnaces.

List of Blast Furnace Blowing Engines of the Automatic Corliss Type.

Diameter of Steam Cylinder.	Diameter of Blowing Cylinder.	Stroke.	Shop Weights. Pounds.	Revolutions per minute ordinary speed.	Cubic feet of Blast Displacement per minute at ordinary speed.	Pressure of Blast, designed to which these engines will work with good economy.	Price of Engine F. O. B., Philadelphia, including Foundation Bolts and Anchor Plates.
40 in.	75 in.	48 in.	175,000	50	12,272	15 lbs. per sq. in.	
40 "	75 "	60 "	223,000	40	12,272	15 " "	
40 "	84 "	48 "	183,000	50	15,392	12 " "	
40 "	84 "	60 "	230,000	40	15,392	12 " "	
45 "	84 "	48 "	220,000	50	15,392	15 " "	
45 "	84 "	60 "	280,000	40	15,392	15 " "	
45 "	90 "	48 "	230,000	50	17,700	12 " "	
45 "	90 "	60 "	290,000	40	17,700	12 " "	

Prices will be quoted upon application.

Balanced Puppet Valve Engines with Variable Cut-Off Gear.

Next in point of steam efficiency to the automatic Corliss is the Variable Cut-Off Engine, illustrated on pages 29 and 30. This is accomplished by the simplest form of gear, without springs or catches, which will wear as long as an ordinary eccentric action and is no more liable to get out of order. The motion may be changed to cut off the steam at any point, between one-quarter and three-quarters follow, while the engine is at work, the point of lead remaining constant and the exhaust unchanged.

The sizes of this type of engine which we manufacture, are given in the accompanying list, where we state the weight of material used in their construction. Prices will be given on application for the engine, as shown in engraving, or with the ordinary double eccentric gear common to puppet valve blowing engines, and with or without platform. This information is given that a better contrast of prices may be made.

Illustrations of the various parts of these engines are shown on pages 40, 41, 43, 45, 46 and 47.

Variable Cut-Off Blast Furnace Blowing Engine.

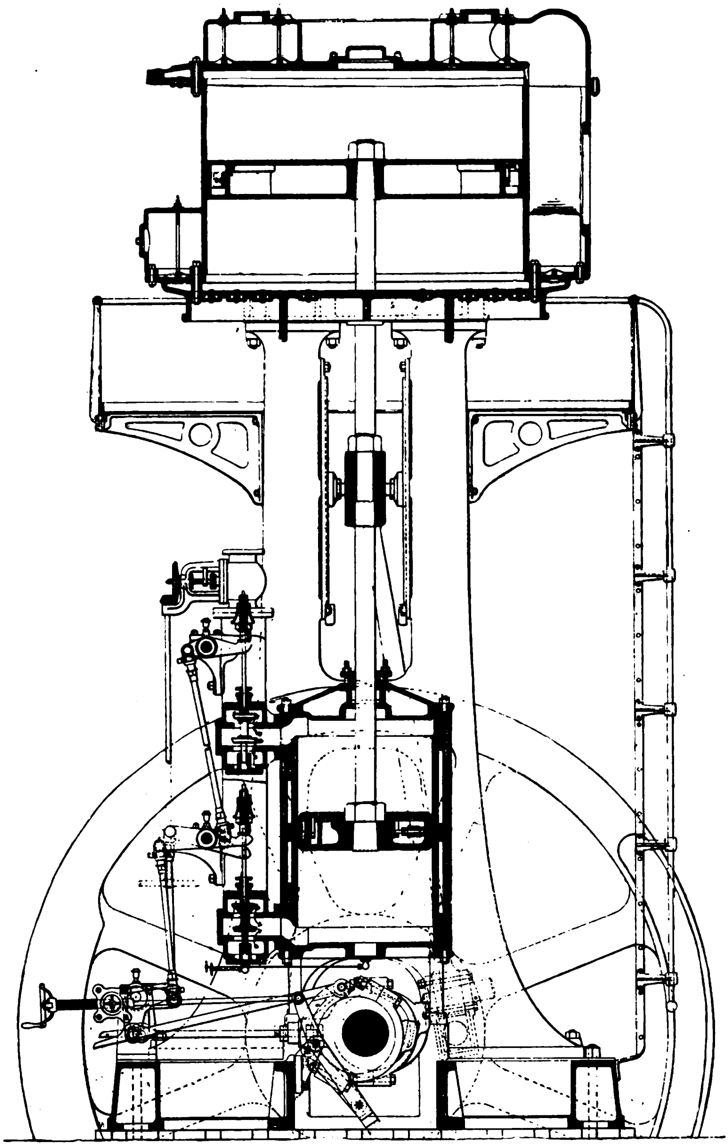


FIG. 17.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

Variable Cut-Off Blast Furnace Blowing Engine.

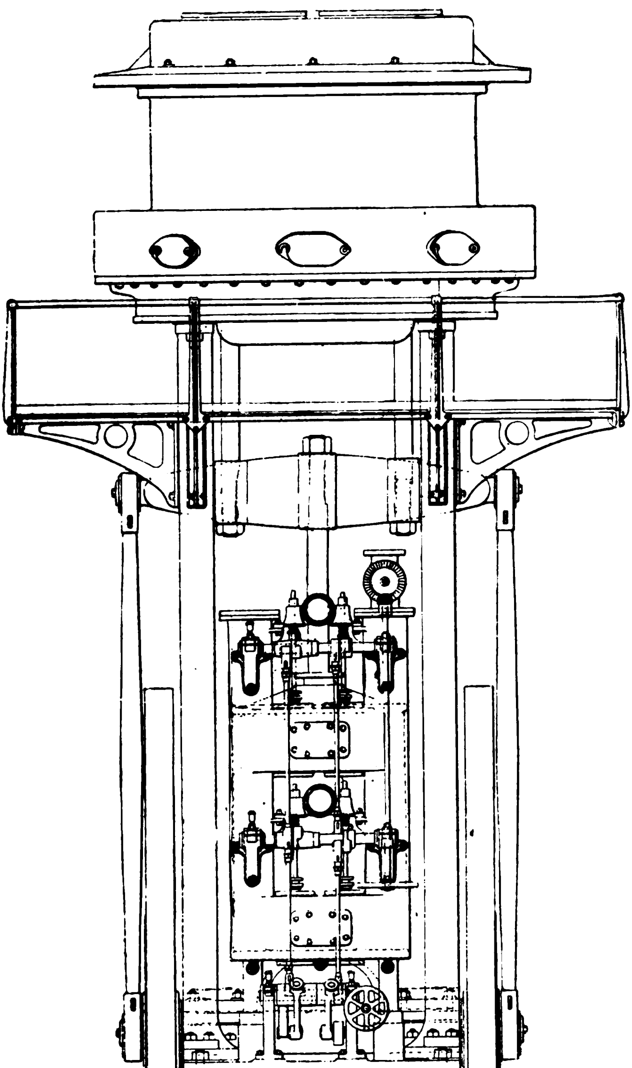


FIG. 18.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

List of Blast Furnace Blowing Engines of the Variable Puppet Valve Cut-off Type.

Diameter of Steam Cylinder.	Diameter of Blowing Cylinder.	Stroke.	Shop Weights, approximate.	Revolutions, ordinary speed.	Displacement of Piston per minute at ordinary speed.	Maximum Blast Pressure for Regular Work.	Price, F. O. B. Philadelphia, including Foundation Bolts and Anchor Plates.
in.	in.	in.	pounds.		cubic feet.	lbs. per sq. in.	
28	66	36	80,000	60	8,550	10	
28	66	48	90,000	50	9,500	10	
32	72	48	106,000	50	11,308	12	
36	72	48	130,000	50	11,308	15	
36	84	48	140,000	50	15,392	11	
36	84	60	165,000	40	15,392	11	
42	84	48	165,000	50	15,392	15	
42	84	60	190,000	40	15,392	15	
42	90	48	170,000	50	17,700	13	
42	90	60	195,000	40	17,700	13	
48	96	48	220,000	50	20,000	15	
48	96	60	280,000	40	20,000	15	

Prices will be quoted upon application.

Prices will be given to provide with these engines a throttling governor, with driving mechanism provided for rapid and extended changes of speed to the engine, as illustrated by *Fig. 14*, page 23.

Duplex Blowing Engines.

Built of either the Variable Cut-off, Corliss Simple or Corliss Compound Condensing Types.

THE engines illustrated on pages 33 and 34 have been referred to on page 27 as the best form for the compound type. When constructed as an automatic Corliss compound condensing engine, it would reach a high point of efficiency. The directions of the strains and general simplicity of form would eminently recommend it for this purpose. Estimates will be given with suitable guarantees of efficiency for any required duty.

The engravings represent our variable cut-off engine with two high pressure cylinders. This form of engine is suited for Bessemer plants and air compressors, giving a steady flow of blast, being highly economical in the use of steam, and easily gotten at for adjustment or repairs. It is controlled by a throttling governor, by which the speed of the engine may be regulated to any desired point within a reasonable range.

Bessemer Blowing Engines, built with either variable cut-off or Corliss valve gear, as illustrated on pages 46 and 36. The blowing cylinder valves, both for the inlet and outlet of the air, are made similar to those shown on pages 40 and 45; but all the valves are steel, faced true on a special emery grinding machine, and seating on accurately machined surfaces. These will outlast any other valve of the automatic type. These engines are built similar in all respects (except the blowing cylinder) to the blast furnace engines of their respective types. The proportion of the steam to the blowing cylinder is such that a velocity of 500 feet of piston speed can be maintained under full duty. During the blow this speed may be much exceeded.

Duplex Blowing Engines.

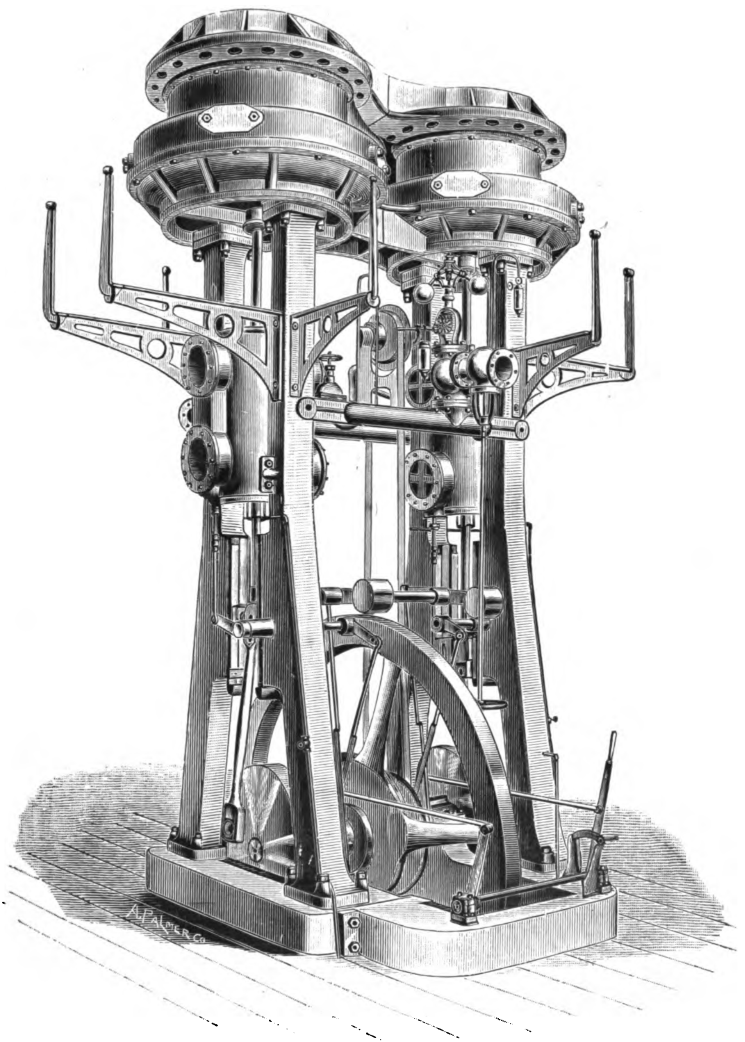


FIG. 19.

Duplex Blowing Engines.

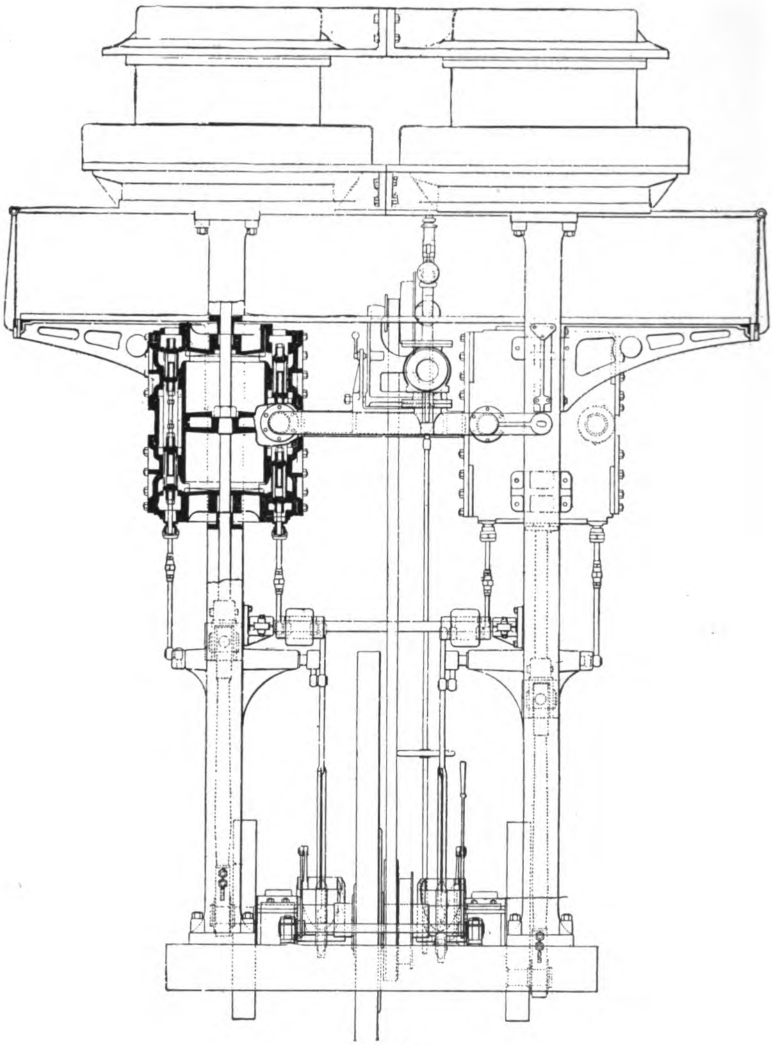


FIG. 20.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

Duplex Blowing Engines.

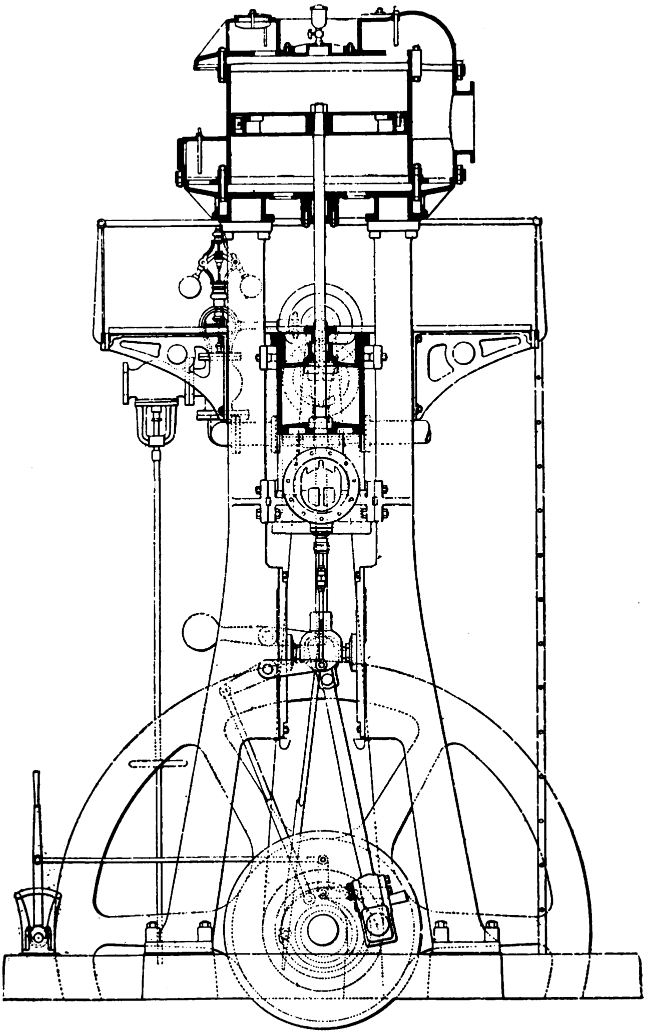


FIG. 21.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

High Pressure Blowing Engine with Corliss Automatic Steam Valve Gear.

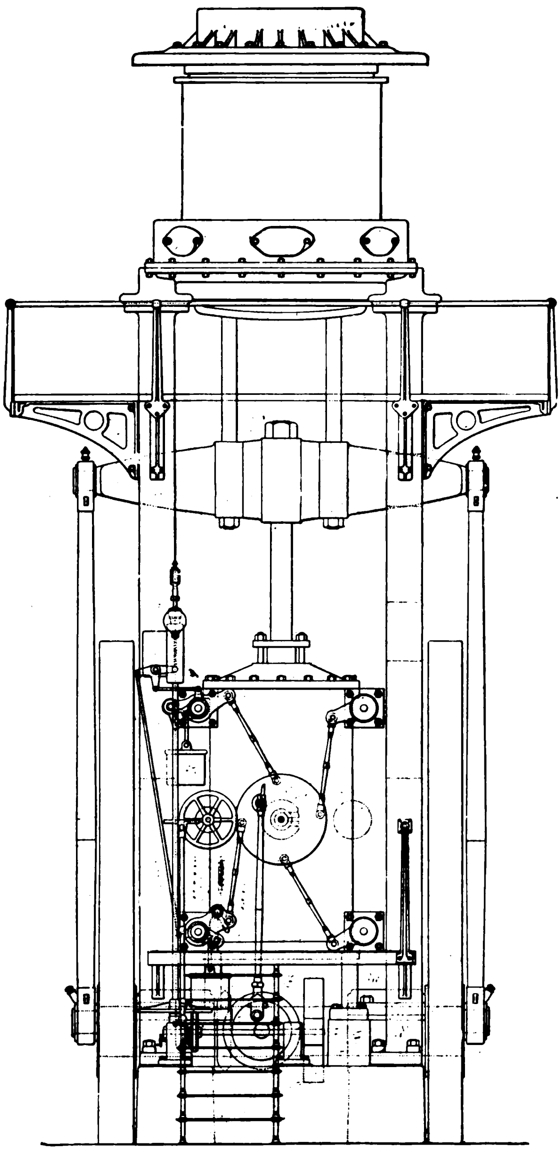


FIG. 22

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

High Pressure Blowing Engine with Corliss Automatic Steam Valve Gear.

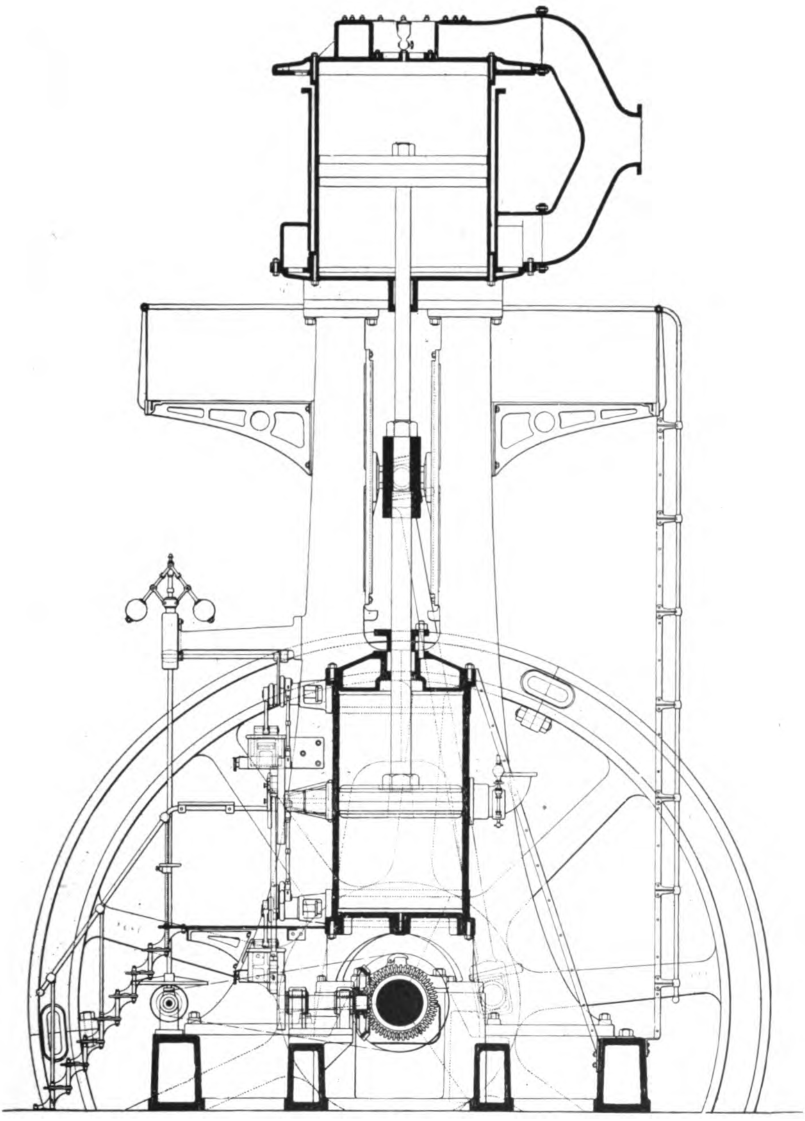


FIG. 23.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

List of Bessemer Blowing Engines, with Variable Cut-off Gear.

Diameter of Steam Cylinder.	Diameter of Blowing Cylinder.	Stroke.	Shop Weights.	Price, F. O. B., Philadelphia, including Foundation Bolts and Anchor Plates.
28 in.	42 in.	36 in.	70,500	
32 "	42 "	48 "	100,000	
36 "	48 "	48 "	130,000	
42 "	54 "	48 "	157,000	
42 "	54 "	60 "	180,000	

List of Bessemer Blowing Engines, with Corliss Valve Gear.

Diameter of Steam Cylinder.	Diameter of Blowing Cylinder.	Stroke.	Shop Weights.	Price, F. O. B., Philadelphia, including Foundation Bolts and Anchor Plates.
40 in	54 in	48 in.	170 000	
40 "	54 "	60 "	218,000	
45 "	58 "	48 "	210,000	
45 "	58 "	60 "	270,000	

Prices will be quoted upon application.

Estimates will be furnished upon application for Bessemer Blowing Engines of the Duplex Type

Special Features of Construction in our Blowing Engines.

BED plates are all box form ; that is, cross sections of the sides and ends are nearly rectangular. This form, with the internal bracing, gives the maximum strength. The bottom is flat, that the foundation may be made solid and the casting bedded true. The top is parallel with the bottom, the main shaft bearings being fitted above the general top level. We look upon this bed plate as composed of two main girders supporting the main shaft bearings and housings, which, with a system of cross bracing, are rigidly secured to each other. Any bending of or cutting into these girders impairs their strength, and as they are subjected to transverse strains, the most severely tested portion is the centre, which should be the strongest ; hence the objection to sinking the main shaft bearing into this casting, even though it be re-enforced on the bottom. Though our plan appears to increase the height of the engine, this is really only an appearance, as the height of the engine must be measured from the bottom of the bed plate, and not from the floor of the engine room. We do, however, increase the height of the engine by raising the steam cylinder well off the main shaft, to keep it cool and to get at it readily when adjustment or repairs are needed.

The plate housings or frames we have discarded for the column housings shown, for the reason that the same amount of metal put in four rectangular columns is much stronger than when put in two large plates. This system of construction which we follow has been universally adopted in marine engineering. There is also the great advantage of getting at the engine more readily.

We have adopted the three piston rod plan, seen on cross-head *Fig. 25*, page 41, and use it, except when otherwise stipulated by contract. Of the oscillating cross-heads, the best is that shown in *Fig. 26*, page 41.

Our reasons for preference of plan *Fig. 25* are that the strain is more evenly distributed on the cross head and the blast piston, a closer connected engine is obtained, the piston rods are secured in a more satisfactory man-

Details of Blast Cylinder.

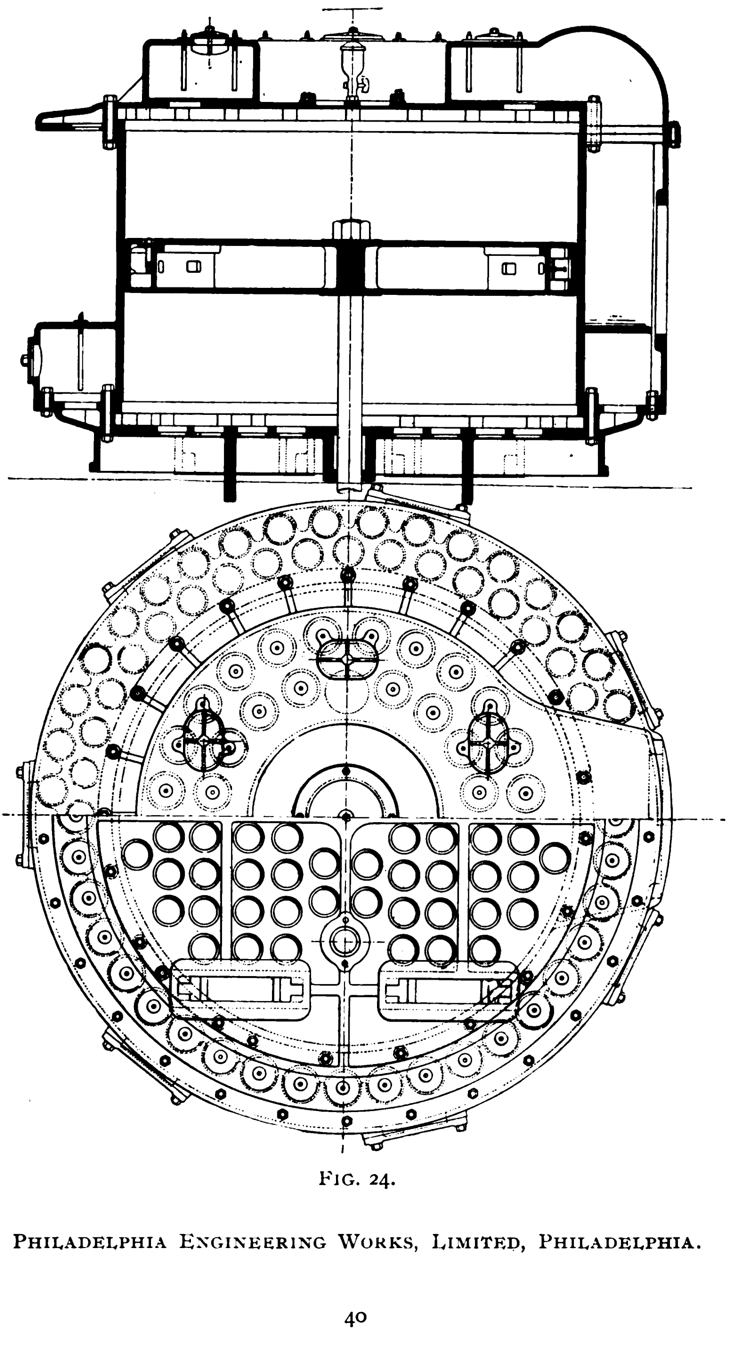


FIG. 24.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

Details of Cross Heads.

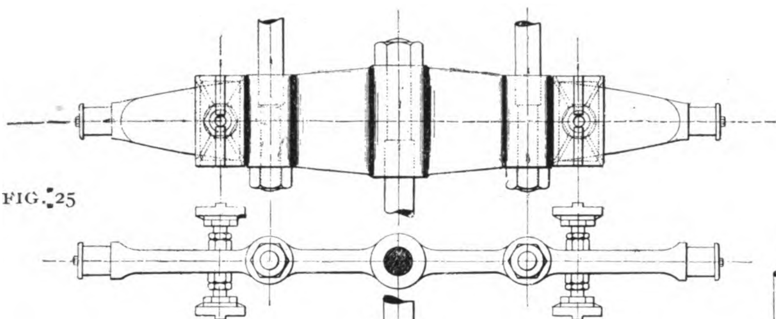


FIG. 25

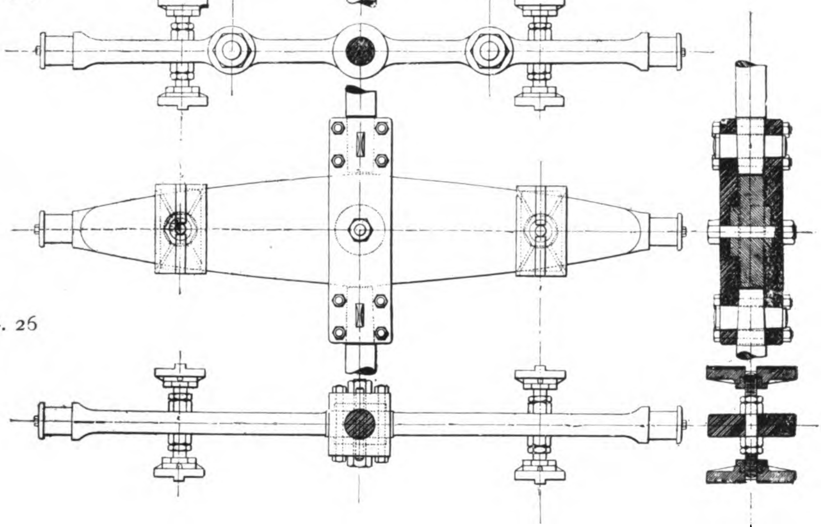


FIG. 26

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

ner, and the engine can be gotten at more quickly when any accident happens. The oscillating cross head is a relic of the past, and was introduced to meet imperfect workmanship. With crank plates put on as described below, whereby accuracy is assured, and where large wrist pins are used (that will not require lining up once a year), the matter of keeping the two connecting rods of equal length becomes a simple proposition.

The fly wheels are so designed (see page 43) that the centre plates are shipped with the shaft and wrist pins in place. In constructing them at our works, the plates are first bored and faced, and then the wheel segments are fitted to them, bolt holes reamed and all carefully marked. The centre plates are then forced on the shaft, and finally keyed on, after which, by the aid of special tools, the crank pin holes are bored and hubs faced, thus insuring accuracy in radial distance and alignment.

The blowing cylinder (see page 40) has both inlet and outlet valves so disposed that the least possible dead space or clearance is secured, while every valve seats by gravity, requiring neither springs nor counterweights. The aggregate area of these valves is very large, securing a free ingress and egress to the air. A diagram (see *Fig. 33*, page 47) taken from one of this type of blowing engines, shows neither suction on the inlet side, due to the air being impeded at entrance, nor compression on the discharge side. This is due not only to the large area through the seats, but to the freedom with which the valves open. The inlet valves of the blast furnace engines are of the best sole leather, which rise from their seats with the slightest current of air. If they were held to their seats by springs, the ingoing air current must overcome the resistance of these springs, which, though slight when the valve is just leaving the seat, rapidly increases, soon presenting a formidable resistance to the entering air. This is especially true if the valves are made small.

Our outlet valves are lifted from their seats as easily as our inlet valves. They are slightly heavier than the inlet, due to the additional weight of an attached plate of steel one-sixteenth of an inch thick.

All valves seated by springs, no matter how weak, when the valves leave their seats (heavy valves or small valves with leather hinges), present a serious impediment to the air currents at high speeds.

Our valves are illustrated on page 45. *Fig. 28* shows the outlet valve; the seat is set into the head, its lowest surface being even with the inside of the cylinder to avoid clearance. This seat is faced where it rests on the cylinder head casting, requiring no jointing, such as sheet gum, etc. The surface upon which the steel valve seats is faced true, and the steel valve (turned on the edge and ground by special emery grinder) plays between bored guides. The guard holding the seat in place and receiving the upward blow of the valve is held in place by a centre bolt. This bolt is released

Details of Fly Wheels.

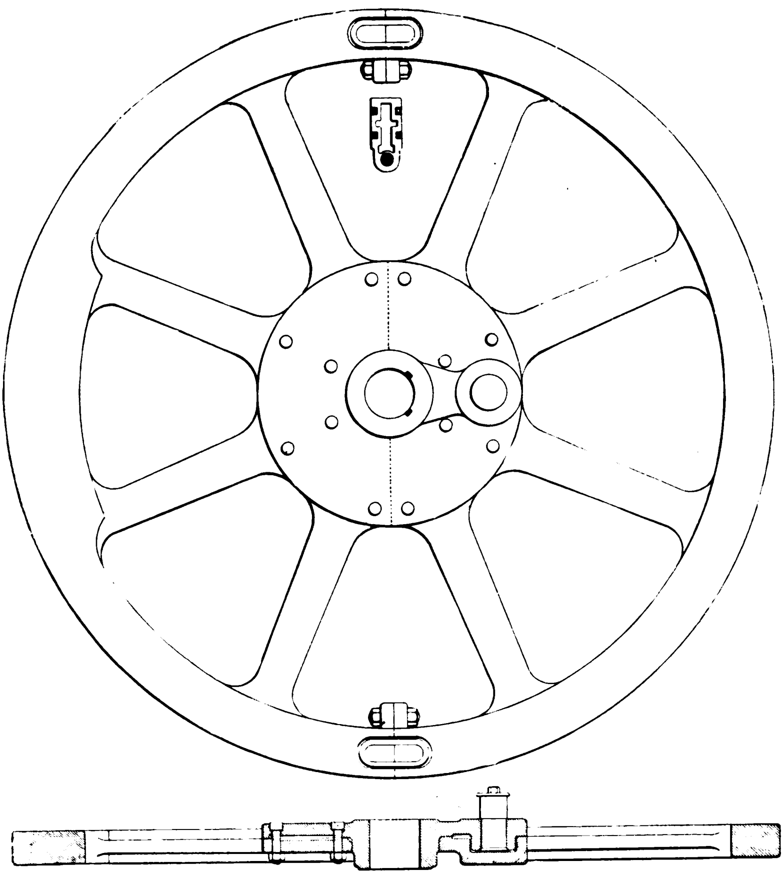


FIG. 27.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

from outside the cylinder, and the guard, valve and valve seat may be at once removed through the hand holes shown. The blows of the lifting valves are received by leather discs.

Fig. 29 shows the inlet valves. The seat, as in the outlet valves, is set into the head or machined surface, and is secured by a single bolt from a three-legged guard and valve guide. These valves all seat by gravity, so by removing the nut on the central bolt the seat and valve are taken out, and a new valve inserted quickly.

Diagram, page 46, shows the action of our variable cut-off gear, and *Figs. 31* and *32*, page 47, are indicator cards taken from one of our blowing engines supplied with this gear. From this diagram it will be observed how perfect is the action of this gear. In the variation of the follow, from one-quarter to three-quarters stroke, the lead never varies in the least, while the exhaust gives an equally free escape to the steam.

Details Inlet and Outlet Blast Valves.

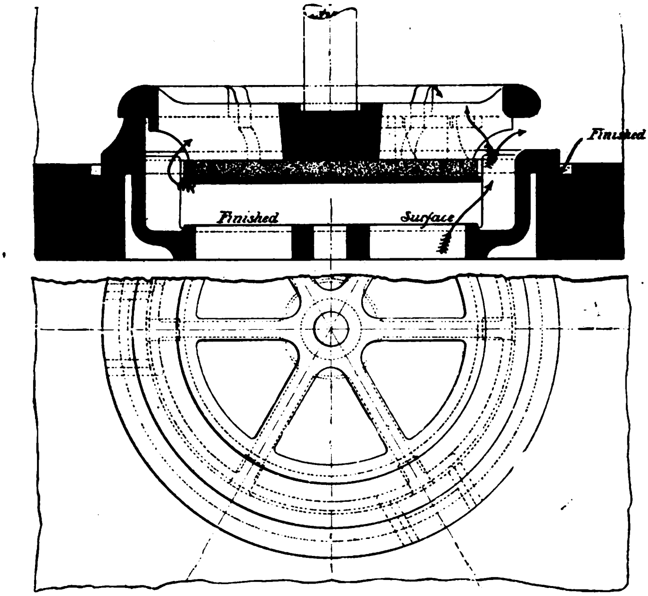


FIG. 28.

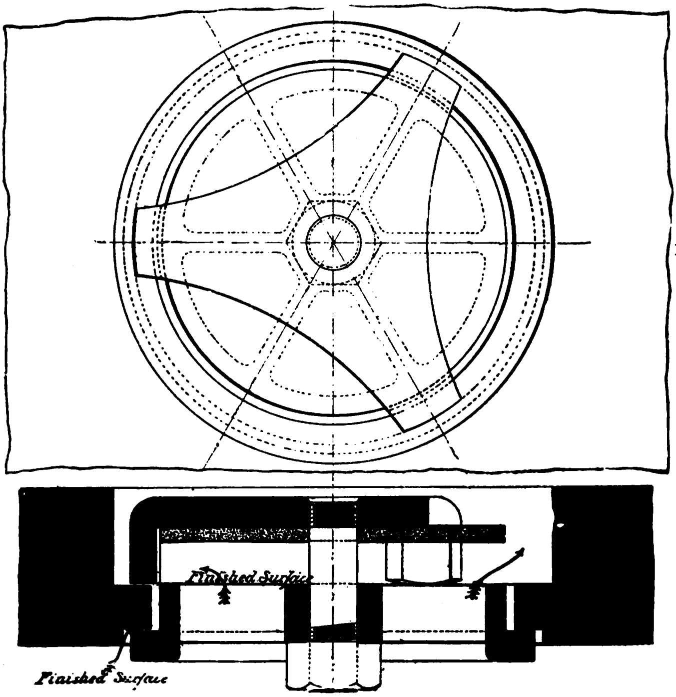


FIG. 29.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

Diagram of Valve Gear.

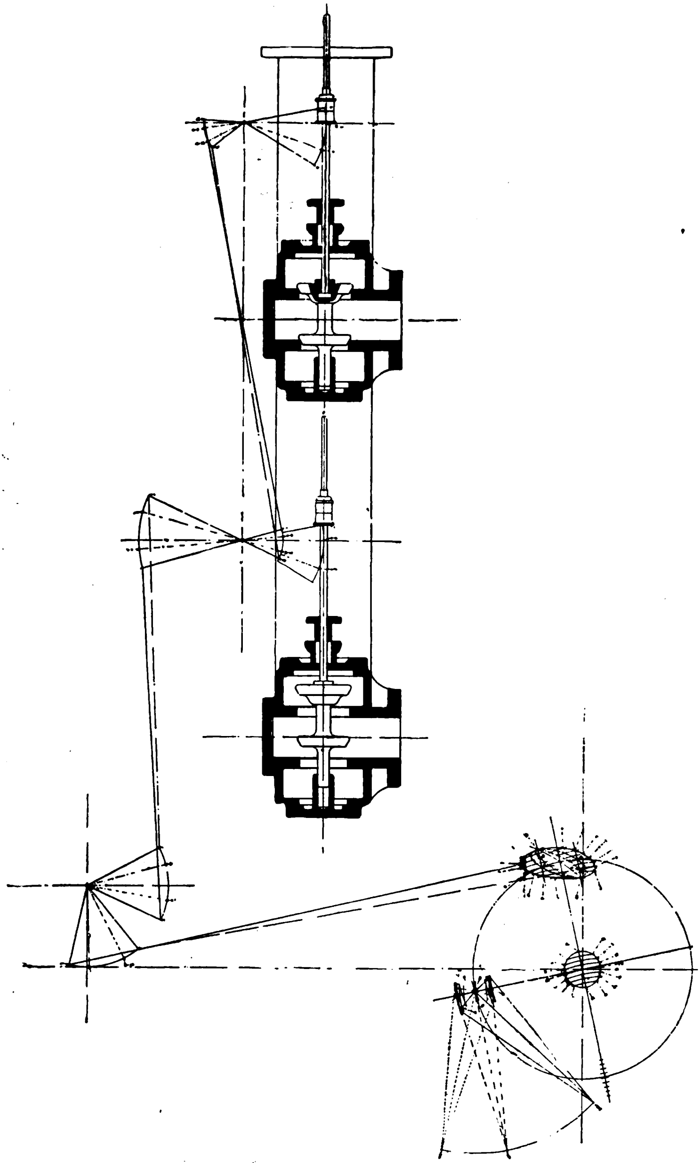


FIG. 30.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

Illustration of Indicator Diagrams

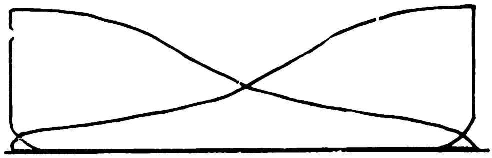


FIG. 31. STEAM CYLINDER.

Steam cylinder, 36 inches diameter, 48 inch stroke.
Revolutions, 34. Cut off at ¼ stroke.
Spring, 40 pounds.
Steam pressure, 60 pounds. Throttle wide open.
Average effective pressure, 30.6 pounds.

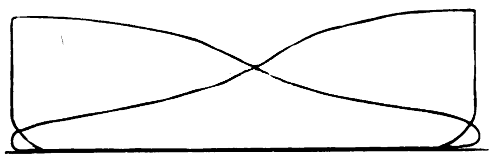


FIG. 32. STEAM CYLINDER.

Cut off in ⅜ notch.
Engine throttled.
Revolutions, 34.
Steam pressure, 60 pounds.
Spring, 40 pounds.

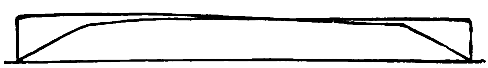


FIG. 33. BLOWING CYLINDER.

Blowing cylinder, 48 inch stroke, 84 inch diameter.
Revolutions, 31.
Spring, 10 pounds.
Blast pressure by gauge, 4.5 pounds.
Average pressure, 3.92 pounds.

Letters of Reference Appertaining to Blowing Engines.

SHEFFIELD AND BIRMINGHAM C. I. & RY. CO.

Sheffield, Ala., September 22, 1889.

GORDON, STROBEL & LAUREAU, Ltd.,
Philadelphia, Pa.

DEAR SIRS: Replying to your inquiry will say: from the records kept by myself, of the work done by your Gordon Blowing Engines, for the purpose of determining their efficiency, I find for the work just closed, that after deducting ten per cent. for clearances in the air cylinders, and leakages from pipes and connections, that the displacement of air averaged for the work four and seventy-three one-hundredths tons per ton of iron made, which is very close to theoretically perfect work, and better work than I have ever before witnessed with ores yielding about fifty per cent.

With two seven-foot cylinders, four-foot strokes, running for twenty-three hours at full normal speed of (say) forty-five revolutions per minute, and yielding at the same rate, the furnace would turn out 262 tons of 2,240 pounds. The conclusion is that the air valve area and action are extraordinarily correct and perfect, the furnace getting the full benefit of every stroke of the engine. An experiment made to determine the power of the engine developed the following results:

With the cut-off set at one-half stroke, and the steam pressure at sixty-five pounds, the engine ran smoothly at thirty-six revolutions, with blast pressure at ten and one-half pounds, the diameter of the steam cylinder being thirty-six inches and the air cylinder eighty-four inches. We would be unreasonable not to accept this as very excellent work.

Very truly yours,

EDWARD DOUD,
Supt. Furnace Dept.
S. & B. C. I. & Ry. Co.

WAUGH STEEL WORKS.

Belleville, Ill., February 25, 1889.

MESSRS. GORDON, STROBEL & LAUREAU, Ltd.,
Philadelphia, Pa.

GENTLEMEN: We have been using one of your Bessemer Engines, 36-inch steam cylinder, 48-inch blast cylinder, 48-inch stroke, in our Converting Works since August 6, 1887, although the service has been unusually heavy, being in constant use up to the present time, having both cupolas and both converters in use for a week at a time, making what is called double headers, without having occasion to stop the engine. We blow up to four tons, on an average, at one heat. The revolutions have averaged seventy a minute; the blast pressure from fifteen to twenty pounds. The boiler steam pressure averages eighty-five pounds. We cut off at three-fourths of the stroke, and find no difficulty in maintaining pressure. The disc valves work thoroughly, and believe maintenance has been as low as in any engine of this type. We are so well satisfied with the working of the engine, that when it becomes necessary to add an additional one, which we expect to do soon, it will be to duplicate the one we have, being so well pleased with it.

Respectfully,

WAUGH STEEL WORKS.

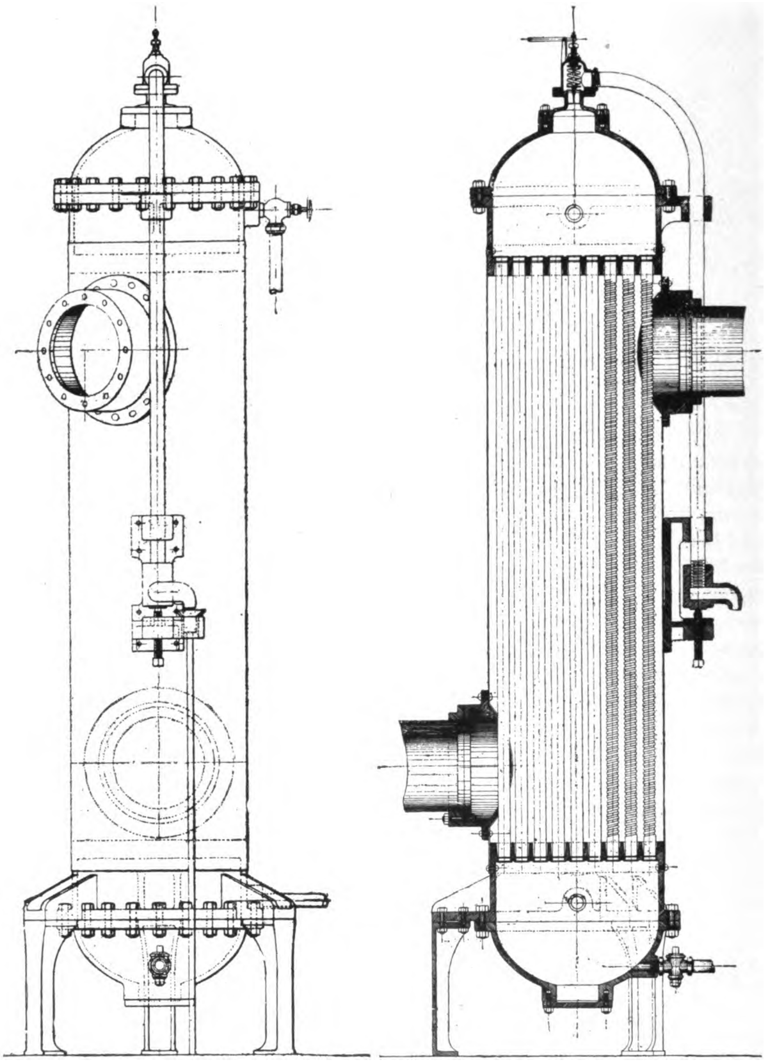


FIG. 34.

PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA.

Feed Water Heater.

THE Feed Water Heater, illustrated on page 50, is eminently suitable for blast furnaces, rolling mills and steel plants. We make them in sizes ranging from ninety to 1,000 horse-power. The water from the feed pumps enters the heater at the bottom in the large settling chamber, rising through the tubes at the rate of about fifty feet per minute, equal to one-half mile per hour, a speed so slow that the solid materials, as the water is heated, are precipitated to the lower chamber, where they may be blown off through the cock provided for that purpose. The heated water passes to the boiler through the valve at a point near the top, but below the dome cover. The object of introducing the water at a point above the bottom head and taking it off from a point below the top head is, that these heads may be removed for thorough overhauling and cleaning, without breaking any of the connections. The upper head, through which the principal cleaning is done, is arranged to be lifted slightly by a screw, and swung round out of the way, any large scales being removed through the cleaning door at the bottom. This can be thoroughly done while the engine is in motion. The crane is an extra heavy pipe, which carries the water from the safety valve on top. This valve serves to relieve the pipes and pumps of excessive pressure, due to the boiler tender closing down the regulating valves on the boiler more than the pump speed will justify. It is also provided with a lever that it may be regularly used as a blow-off to remove the scum, etc., which accumulates on top of the heated water. The inlet for the exhaust steam is at the top of the heater by preference, that the hottest steam may heat the water just as it leaves the heater, and that the heater may serve to catch the condensed water from the exhaust, which may be drawn off and fed to the feed pump. This pure hot water will constitute a very large proportion of the feed water when the engine is working with good economy.

List of Feed Water Heaters.

Horse-power.	Diameter Shell.	Height over all.	Diameter of Exhaust.	Diameter of Feed Pipe.	PRICE.
50	12	6	5	1¼	$45.00
100	12	8	6	1¼	55.00
150	14	8	6	1½	65.00
200	14	10	7	1½	80.00
250	18	8	7	2	100.00
300	18	10	8	2	120.00
350	18	12	8	2	150.00
400	24	10	8	3	250.00
450	24	10	8	3	300.00
500	24	12	10	3	350.00
550	24	12	10	3	400.00
600	30	10	10	3	450.00
650	30	10	10	3	500.00
700	30	12	12	4	600.00
750	30	12	12	4	750.00
800	30	12	12	4	900 00
850	36	10	14	4	1050.00
900	36	10	14	4	1200.00
950	36	10	14	4	1400.00
1000	36	12	14	5	1750.00
1200	36	12	16	5	2000.00
1500	36	12	18	6	

Discount, ...

Iron Chimneys for Blast Furnaces and Rolling Mills.

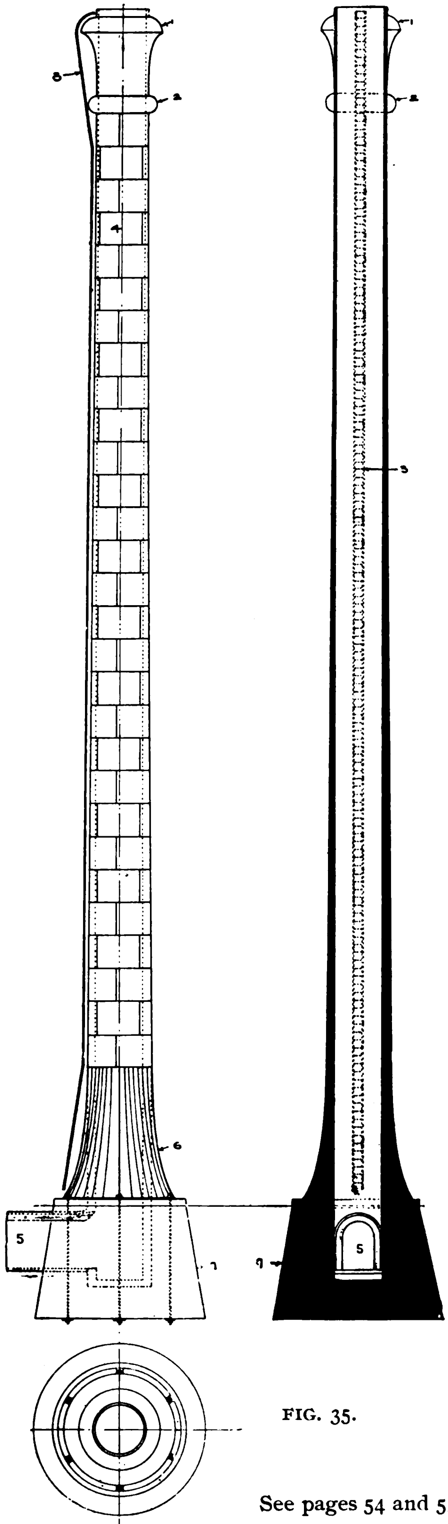


FIG. 35.

See pages 54 and 55.

Iron Chimneys for Blast Furnaces, Rolling Mills and for All Kinds of Factories.

WE illustrate herewith two forms of Iron Chimney, which we are prepared to build in all sizes. The casing of the chimney is made of plate iron, strongly riveted, and forming a continuous shell from base to top. It is riveted at the bottom to a heavy cast iron foundation plate ring, secured to the foundation by bolts. At the top it is surrounded by a plate-iron ornamental casing, as shown. A wrought iron ladder, fastened to the shell, extends from the ground to the top.

The chimneys are built with or without fire-brick lining, depending upon the temperature of the escaping gases; the thickness of the lining varying for the different diameters and heights.

Figs. 35 and *37* illustrate the chimney arranged for underground gas flues, and *Fig. 36* for overhead flues, being built on a brick base, provided with openings to receive the gas flues.

The chimneys are self-sustaining, requiring no guy rods or other fastenings. Their weight, assisted by bolts passing through the foundation of brick or stone, will resist the highest wind pressures.

The enormous quantity of brick and material necessary for brick chimneys requires massive foundations and much space. Should these foundations sink but a trifle, the chimney may crack or fall. They are poor conductors of electricity, as was exemplified in the large brick chimney at the Clark Thread Works, Newark, N. J., which was nearly destroyed by lightning. Heavy chilling rain or sleet storms striking on one side of warm chimneys has totally ruined excellent structures.

The foundations of iron chimneys may sink out of level, and the whole structure lean at a considerable angle, without endangering its fall. They are the very best of lightning conductors; and sudden changes of temperature, by sleet or rain storms striking on one side, have no perceptible effect upon them. They are altogether more reliable against wind storms.

We have been building iron chimneys, as shown, for the last twenty years, in all parts of the country, and of all sizes, from the smallest to the largest, and have never known of a single instance of trouble with one of them. This type of chimney has, by practice, been largely confined to use in connection with iron and steel plants. It is much cheaper for the same size, and this, combined with its greater durability and strength, makes it much more desirable for boilers, for all kinds of factories, for brick and pottery kilns, and all other purposes.

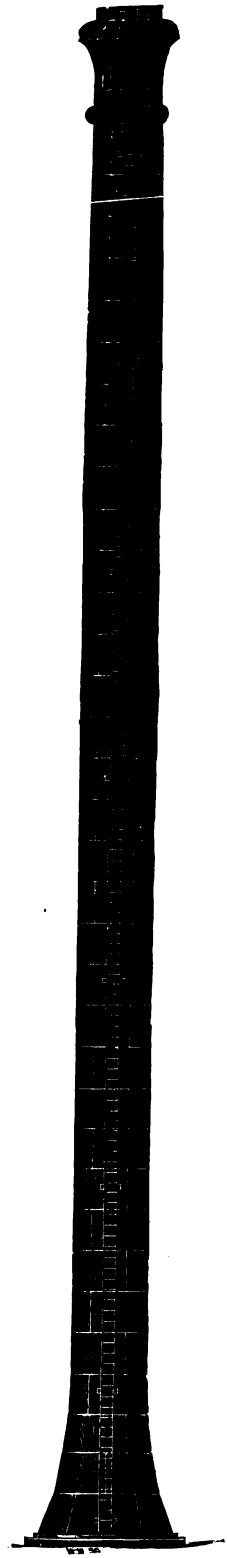


FIG. 37.

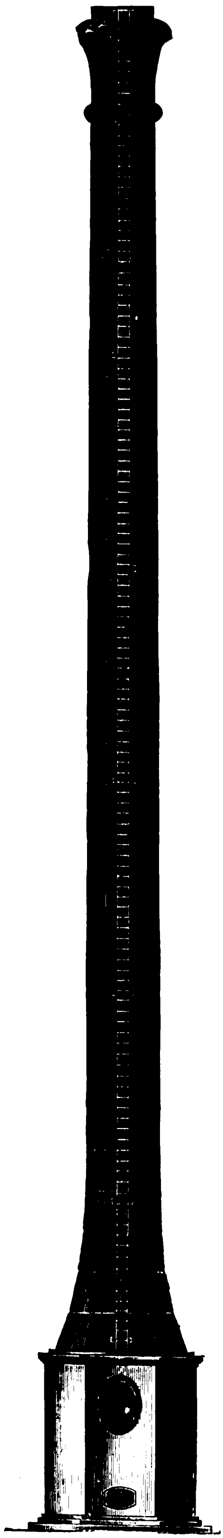


FIG. 36.

Relative Working Dimensions of Factory Chimneys, Total Grate Areas, and Consumption of Coal.

Horse-Power.	Diameter in Clear.	Height.	Coal consumed per Hour.	Total Area of Grate Surface required.	Least Diameter Foundation.	Least Depth Foundation.	Price, Chimney Half Lined.	Price, Chimney Full Lined.
188		70	940	63	12'	5		
201	36	80	1,005	67	12'	5		
213		90	1,065	71	12'	5		
223		100	1,125	74	12'-8"	8		
221		70	1,105	73	12'-8"	5		
237		80	1,185	79	12'-8"	5		
251	39	90	1,255	83	12'-8"	5		
265		100	1,325	88	12'-8"	8		
277		110	1,385	92	12'-8"	8		
301		80	1,505	100	11'-8"	5		
319		90	1,595	106	11'-8"	5		
337	44	100	1,685	112	11'-8"	8		
353		110	1,765	117	11'-8"	8		
374		125	1,870	124	11'-8"	9		
389		80	1,945	129	12'-10"	5		
414		90	2,070	138	12'-10"	5		
436	50	100	2,180	145	12'-10"	8		
457		110	2,285	152	12'-10"	8		
484		125	2 420	128	12'-10"	9		
531		150	2,655	177	13'-11"	10		
500		90	2,500	186	13'-11"	5		
527		100	2,635	176	13'-11"	8		
553	55	110	2,775	184	13'-11"	8		
585		125	2,925	195	13'-11"	9		
642		150	3,210	214	13'-11"	10		
596		90	2,980	178	13'-11"	5		
628		100	3,140	209	13'-11"	8		
660	60	110	3,300	220	13'-11"	9		
697		125	3,485	232	13'-11"	9		
766		150	3,830	155	15'-1"	10		
722		90	3,610	240	15'-1"	5		
760		100	3,800	253	15'-1"	8		
800	66	110	4,000	266	15'-1"	8		
843		125	4,215	281	15'-1"	9		
927		150	4,635	309	15'-1"	10		
904		100	4,520	301	15'-1"	8		
950	72	110	4,750	316	15'-1"	8		
1003		125	5,015	334	15'-1"	9		
1102		150	5,510	367	16'-1"	10		
1061		100	5,305	353	16'-1"	8		
1115	78	110	5,575	371	16'-1"	8		
1177		125	5,875	392	16'-1"	9		
1295		150	6.475	431	16'-1"	10		
1231		100	5,155	410	17'-5"	8		
1292	84	110	6,460	430	17'-5'	8		
1366		125	6,830	455	17'-5"	9		
1501		150	7,505	500	17'-5"	10		
1568	90	125	7,840	522	18'-7"	9		
1723		150	8,615	574	18'-7"	10		
1784	96	125	8,920	594	18'-7"	9		
1961		150	9,805	653	18'-7"	10		
2482	108	150	12,410	827	19'-9"	10		
3065	120	150	15,325	1021	21'	10		

NOTE TO TABLE.—The side of a square chimney, equal in top sectional area to a round chimney, is found by multiplying the given diameter by .886.

The above is D. K. Clark's recommendation for factory chimneys, adding our own calculations for the horse-power, at the rate of five pounds of coal per horse-power per hour. This table gives the consumption of coal per hour. It is the true data from which to measure a chimney. We should be pleased to have our correspondents state, as near as may be, what the coal consumption will be. The horse-power of a boiler is rated at thirty pounds of water evaporated at seventy pounds pressure from 100°. Those who can depend upon a higher boiler evaporation, can reduce the size of the chimney somewhat.

Charging Barrows for Blast Furnaces, Rolling Mills, Gas Works, Sugar Refineries, Brick Yards, Etc.

The bodies of the barrows, *Figs. 38* and *39*, are made of steel plate. The sides are one-eighth inch thick, the bottom three-sixteenths inch thick, strongly jointed and strengthened with angle and iron bars, or they can be made any thickness desired.

The body of the barrow, *Fig. 40*, is made of steel plate. The sides are one-sixteenth inch thick, and the bottoms five-thirty-seconds inch thick.

The wheels are made in two sizes—thirty-two and thirty-four inches in diameter. The tires are made of wrought iron. The spokes are wrought iron, riveted at the outer end to the tire ; an iron hub is cast or fitted to their inner ends. They are provided with adjusting nuts, by which arrangement the wheel can always be kept round and in tension.

Each wheel is fitted to an independent axle, working in bearings contained in one casting, insuring at all times perfect alignment of the axles.

The legs and handles in all cases are made of wrought iron, securely braced and riveted to the bodies, as shown in *Fig. 40*.

FIG. 38—ROUND BODY ORE BUGGIES.

Capacity Bush.	Capacity Cubic Feet.	Length over all.	Width over all.	Height over all.	Diam. of Wheel.	Weight.	List Price.
7.3	11	62	33½	41½	34	628	$62.50
8.3	12½	62	33½	43½	34	650	65.00
8.3	12½	62	37	41½	34	650	65.00
9.3	14	62	33½	45½	34	670	67.50
9.3	14	62	37	43½	34	670	67.50
10.3	16½	62	33½	47½	34	750	70.00
10.3	16½	62	37	45½	34	750	70.00
11.3	18	62	33½	49½	34	725	72.50
11.3	18	62	37	47½	34	725	72.50

FIG. 38—ROUND BODY COKE BARROWS.

9.3	14	62	33½	45½	34	625	$62.50
9.3	14	62	37	45½	34	625	62.50
10.3	16½	62	33½	47½	34	650	65.00
10.3	16½	62	37	47½	34	650	65.00
11.3	18	62	33½	49½	34	675	67.50
11.3	18	62	37	49½	34	675	67.50

FIG. 39—SQUARE BODY COKE BARROWS.

20	30	64½	42½	50½	32	755	$75.50
18	27	64½	39½	50½	32	725	72.50
16	24	64½	36½	50½	32	700	70.00
14	21	64½	33½	50½	32	675	67.50

FIG. 40—SQUARE BODY CHARCOAL BARROWS.

20	30	64½	42½	50½	32	600	$60.00
25	37½	64½	45	50½	32	625	62.50
30	45	64½	47½	50½	32	650	65.00

Discount, ...

Charging Barrows.

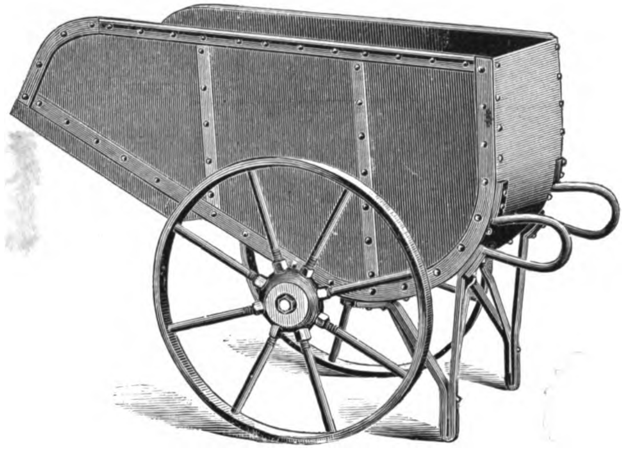


FIG. 38—HEAVY ORE AND COAL BARROW.

FIG 39—HEAVY COKE BARROW.

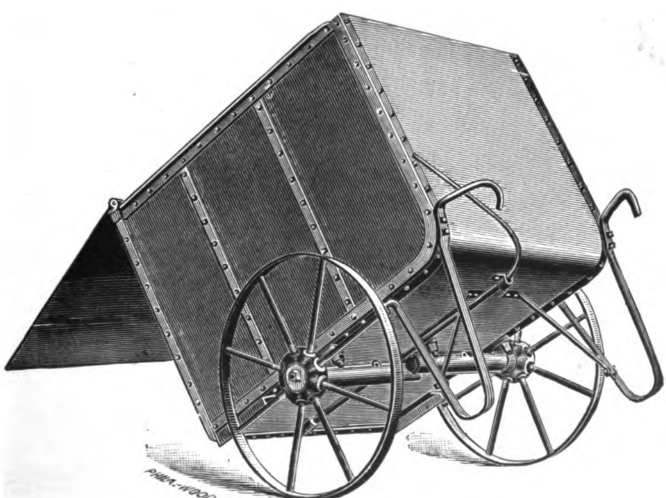
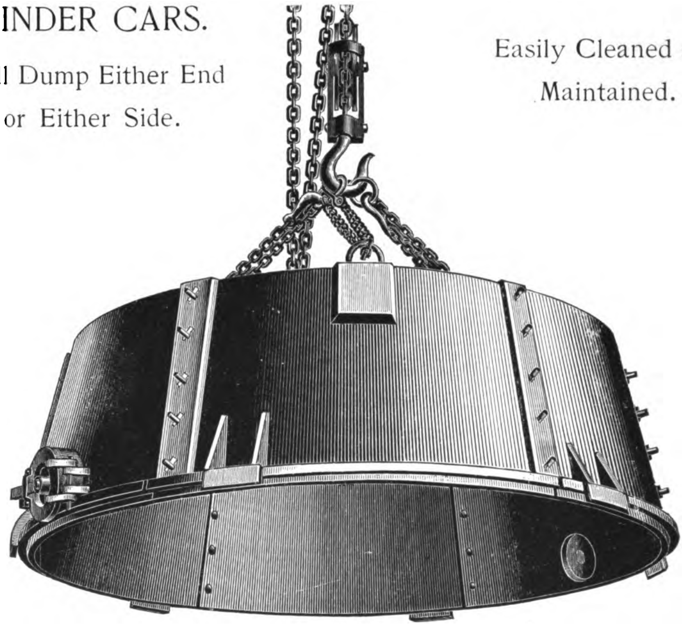


FIG. 40—CHARCOAL OR LIGHT COKE BARROW.

CINDER CARS.

Will Dump Either End or Either Side.

Easily Cleaned **and** Maintained.



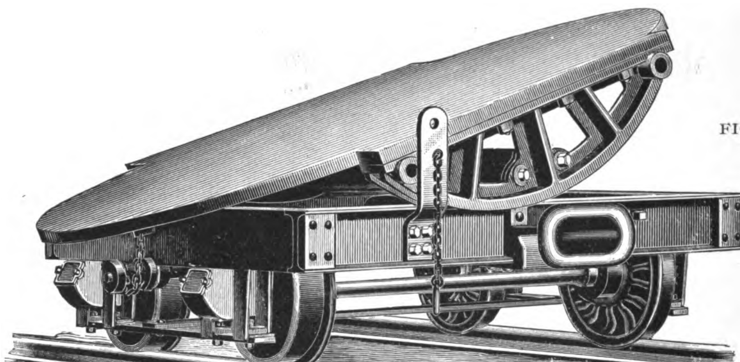


FIG. 41.

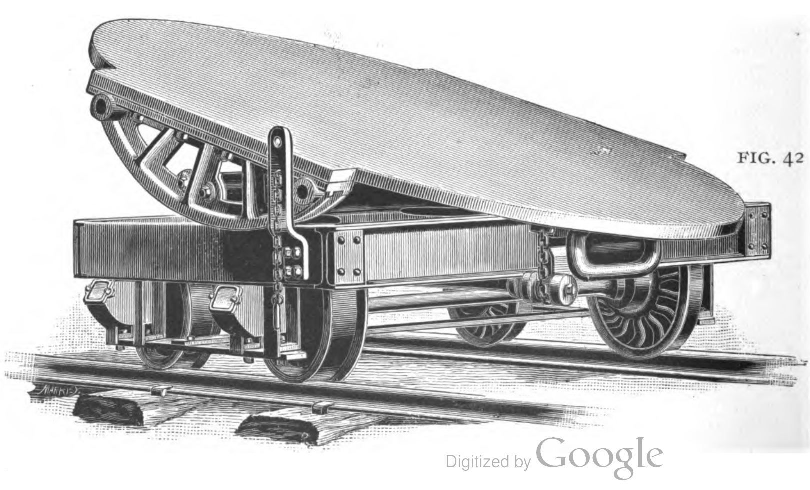


FIG. 42

Cinder Cars for Fluid or Solid Blast Furnace Cinder.

FOR fluid or solid cinder. The car has 120 cubic feet capacity, and holds about six tons of cinder. It is carried upon four wheels, and axles of standard railroad pattern, with oil box journals and standards—the whole weight being carried on springs.

The frame consists of three nine-inch beams each way. Upon these roll three rockers, which are held level, except when dumping, by a pin as shown; upon these rockers the bottom plate of the car is bolted, and upon it sits the tub, which has a decided taper, being smallest at top. The bottom plate is a heavy casting in two sections, held together by the three rockers and three heavy **L** irons. The sides of the tub are made in six segments, bolted together, provision being made for expansion and contraction.

The bottom is sometimes cast with a rim nearly the diameter of the bottom of the tub, within which are laid bricks to protect the bottom from being cut when irons run over from the cinder notch. The cinder will slip from the brick bottom or from the iron bottom with ease, when the car is tipped, after the tub has been raised.

Cast iron sides are much more durable than brick-lined vessels, as any kind of brick is easily fluxed with hot basic cinder.

The peculiarity of this car is that it can be used as above stated for fluid or solid cinder; and it can be tipped either endwise or sidewise. The cinder dump may be increased endwise or sidewise of the track.

When used for fluid cinder, only one fixed crane for elevating the tub is required, which may be a chain block hitched to a beam. The tub being raised from the bottom, entire cleaning is practically effected.

We guarantee the car to do more work than any other, at less expense for arranging the dump, for the maintenance of the car, and for cleaning.

Shipping weight: 15,000 lbs.

Price, f. o. b. Cars Philadelphia, Pa.:

Bell and Hoppers.

DOUBLE LEVER SYSTEM.

Fig. 43, page 61, illustrates our patented parallel link mechanism for raising and lowering furnace bells.

The bells for larger sizes are made with segmental extension pieces bolted to an apex. For smaller sizes they are cast in one piece. The lip rings are cast iron, made very thick at the bearing point. They are made in segments bolted together.

The hoppers are made in segments strongly bolted together on the outside. They rest on circular cast iron plates, supported by cast iron brackets riveted to the furnace shell.

Two I beams are centrally disposed over the bell and supported upon cast iron standards. The bell beams are pivoted in bearings fastened to these beams. A link made of two flat bars connects the two bell beams, and to the centre of this link is pivoted the bell rod. By means of this arrangement the bell will lower concentrically in the furnace, insuring a regular distribution of the stock.

A cylinder is pivoted in bearings attached to the ring under hopper. The piston rod is connected to the bell beam with an adjustable yoke.

To provide against careless handling of the steam cylinder, an air cushioning cylinder is connected to one of the bell beams.

In some cases we introduce an air cylinder to actuate the bell instead of steam cylinder, as described on page 79. The operating levers and valves are erected in the hoist tower house, well away from the bell.

A hand winch and brake, as described on page 79, is also applied in some cases, by means of which the bell may be actuated at times when the furnace is out of blast or when the steam or air supply is low.

The bell mechanism is constructed so a bell or lip ring may be taken out or replaced with the same, thereby avoiding the erection of a special scaffold, etc.

Bell and Hoppers.

SINGLE LEVER SYSTEM.

On the following page, *Fig. 44*, we illustrate our single lever system of operating bells and hoppers. The bell and hoppers (*13*, *14*, *15*) are built substantially the same as those described above, except for small sizes, in which case the bells are cast in one piece.

The standards (*11* and *12*) are made of cast iron, bolted to the ring supporting the hopper.

The beams (*9*) are fastened to the standards (*11* and *12*). A single I beam lever (*17*) is pivoted in bearings (*26*) supported on beams (*9*). The bell (*13*) is actuated by either steam or air cylinder, or friction brake, as described on page 79. A hollow balance-weight (*20*) is attached to one end of the beam (*17*), which can be filled with scrap iron until the desired equilibrium is established.

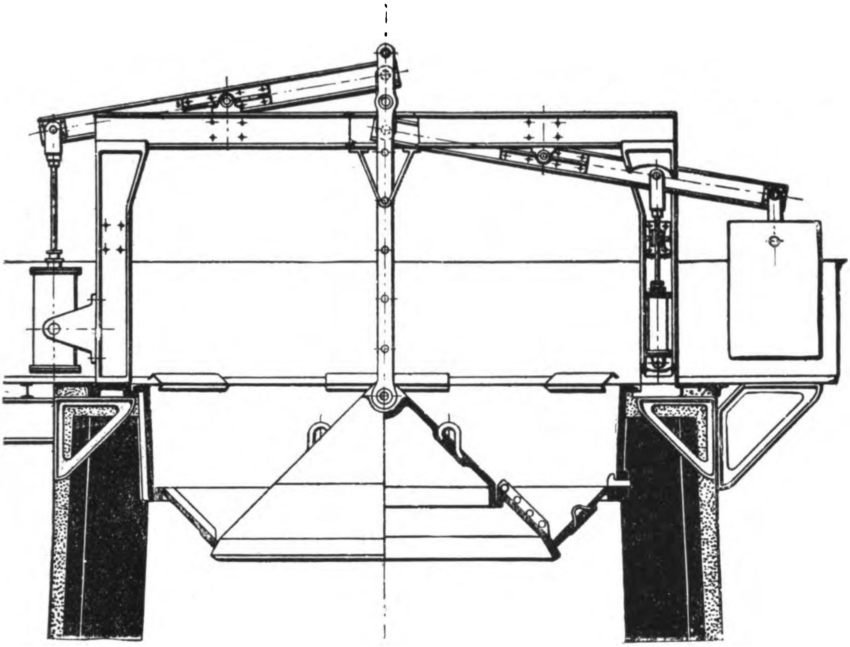


FIG. 43.

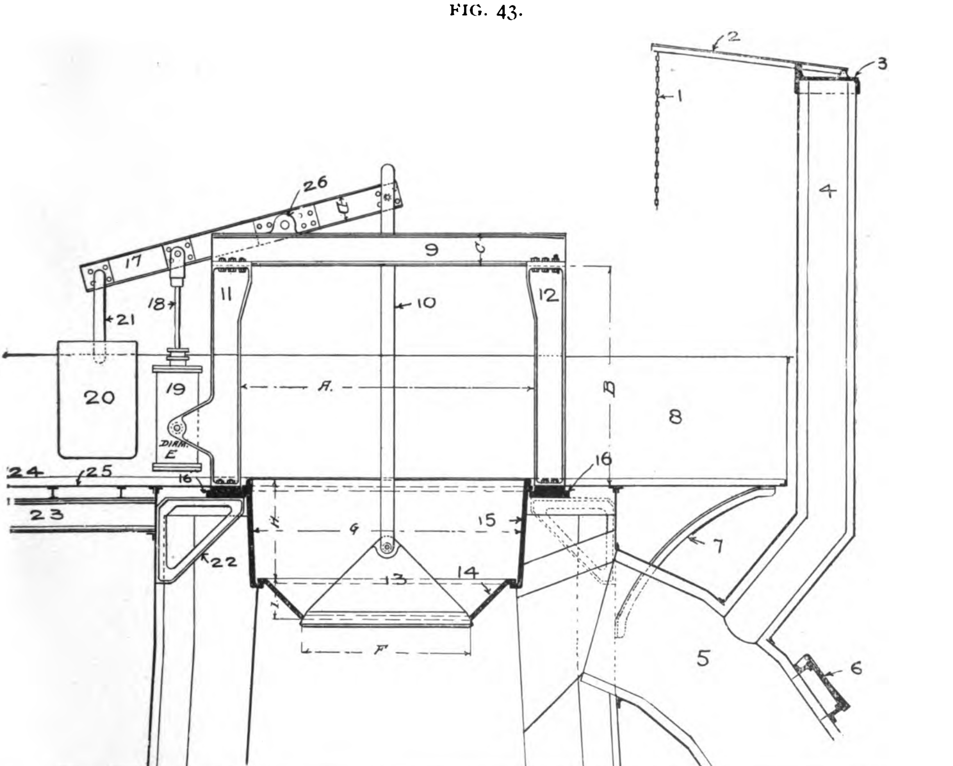

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FIG. 44.

Tuyere Stocks and Blow Pipes.

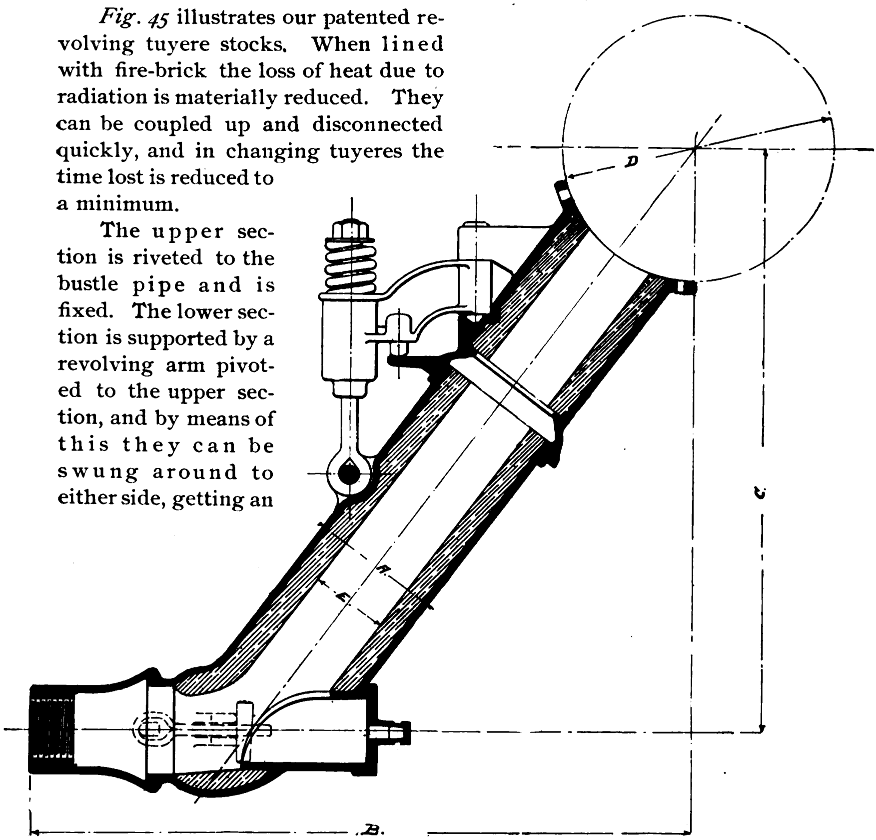


FIG. 45.

Fig. 45 illustrates our patented revolving tuyere stocks. When lined with fire-brick the loss of heat due to radiation is materially reduced. They can be coupled up and disconnected quickly, and in changing tuyeres the time lost is reduced to a minimum.

The upper section is riveted to the bustle pipe and is fixed. The lower section is supported by a revolving arm pivoted to the upper section, and by means of this they can be swung around to either side, getting an abundance of room around the tuyere when changing the same.

A spiral steel spring is supported in the revolving arm through which the hanger bolt passes. This spring will compensate for the expansion of the several parts. The joints are all machined with ball and socket bearings sufficiently long to permit variable adjustments. A cleaning port is provided on the lower section, fitted up complete, with an eyesight and snuffer hole.

The blow pipes, *Fig. 47*, are made of wrought iron threaded upon one end, and turned at the other end to fit the tuyere. The thread is cut to suit nozzle on tuyere stock.

TUYERE STOCKS, WITHOUT BRICK LINING.

	A	B	C	D	E	PRICE.
Fig. 45.	12″	4′ 8″ to 6′ 2″	5′ 0″ to 6′ 0″	24″ to 36″	5″ to 7″	
"	15″	5′ 6″ to 6′ 6″	6′ 0″ to 7′ 0″	30″ to 42″	6″ to 8″	

All prices quoted without brick lining.

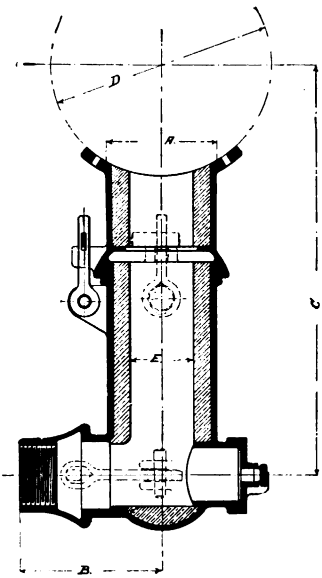


FIG. 46.

	A	B	C	D	E	PRICE.
Fig. 46.	12″	16″	3′ 9″	24″	7″	

Wrought Iron Blow Pipes.

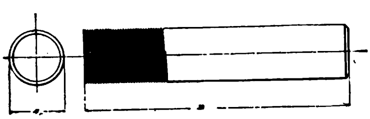


FIG. 47.

	A	B	PRICE.
Fig. 47	4		
"	5	Any	
"	6	Length.	
"	7		
"	8		

Foundation Plates for Furnaces.

The plates are made in segments, securely bolted together. The column bearings in the centre are machined. The diameters given in list can be slightly increased or decreased, thereby getting any diameter from 13′-6″ to 24′-8″.

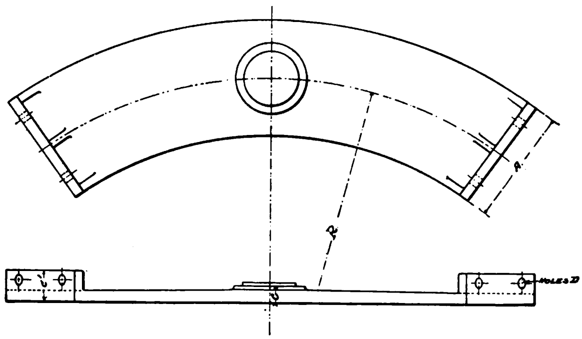


FIG. 48.

A	No Segments B to Ring.	C	R	D	PRICE.
24″	5	2¾″	6′ 9″	2′-2″	
24″	5	2¾″	7′ 3″	2′-2″	
25″	6	3″	7′ 9″	3′-2″	
25″	6	3″	8′ 2″	3′-2″	
26″	6	3¼″	8′ 9″	3′-2″	
26″	6	3¼″	9′ 3″	3′-2″	
26″	7	3¼″	9′ 7″	3′-2″	
30″	7	3½″	10′ 3″	4′-2″	
30″	7	3½″	10′ 7½″	4′-2″	
30″	8	3½″	11′ 6″	4′-2″	
30″	8	3½″	11′ 11″	4′-2″	
30″	8	3½″	12′ 4″	4′-2″	

Cast Iron Columns.

The columns in subtended list can be made longer or shorter than specified, or with circular or square capitals or bases. For furnace work, the bases are machined.

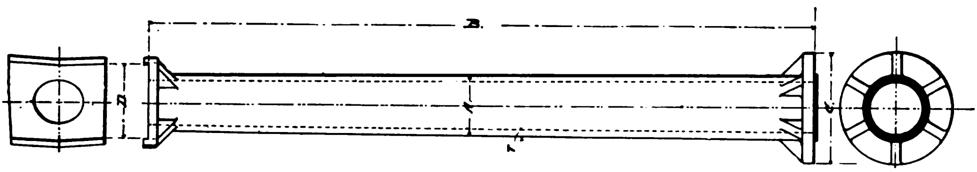


FIG. 49.

A	B	C	D	T	PRICE.
13″	12′ 0″	23″	15½″	1¼″	
15″	16′ 0″	24″	17″	1⅜″	
17″	18′ 0″	28″	21″	1½″	

Small Brackets.

These brackets are made to bolt to the rough surfaces of cast iron columns, and are fitted to the columns by chipping the strips provided on the same.

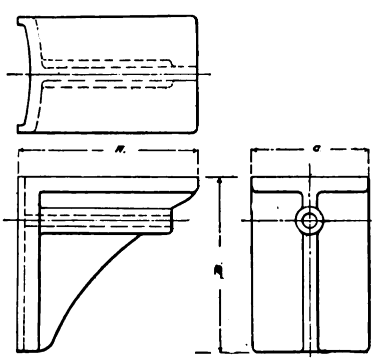


FIG. 50.

A	B	C	PRICE.
12″	12″	8″	
10″	10″	6″	
8″	8″	6″	

Large Brackets.

These brackets can be used for furnace platforms, bell and hoppers, supports for piping, etc.

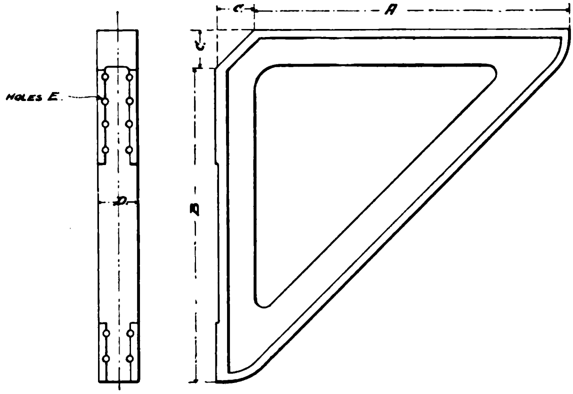


FIG. 51.

	A	B	C	D	E	PRICE.
Fig. 51.	20″	24″	3″	3½″	6-11/16″	
"	24″	24″	3 x 3″	3½″	6-11/16″	
"	24″	15″	3 x 3″	3½″	6-11/16″	
"	26″	30″	3¾″	4″	8-11/16″	
"	30″	30″	3¾″	4″	6-11/16″	
"	33″	33″	3½″	4″	6-11/16″	
"	34″	34″	3¾″	4″	8-11/16″	
"	36″	36″	3¾″	4″	8-11/16″	
"	38″	38″	3¾″	4″	12-11/16″	

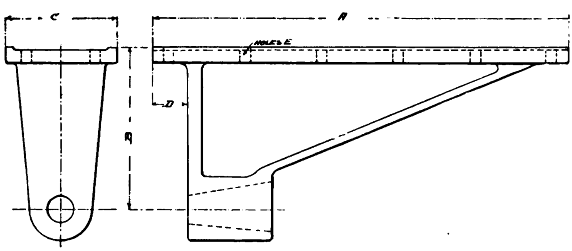


FIG. 52.

	A	B	C	D	E	PRICE.
Fig. 52.	30″	11½″	8″	2½″	13-11/16″	

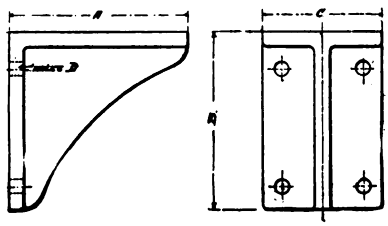


FIG. 53.

	A	B	C	D	PRICE.
Fig. 53.	9″	9″	9″	4-15/16″	
"	12″	12″	9″	4-15/16″	
"	9″	9″	8″	4-13/16″	
"	12″	12″	8″	4-18/16″	
"	12″	8″	6″	4-13/16″	
"	8″	6″	4″	4-13/16″	

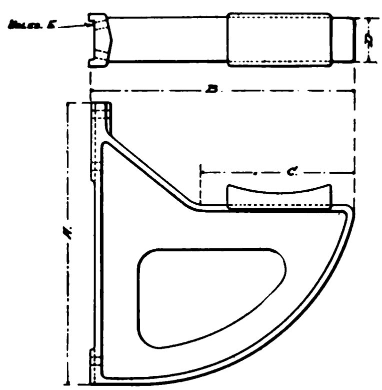


FIG. 54.

	A	B	C	D	E	PRICE.
Fig. 54.	31″	30″	18″	5″	6′-1″	

Bronze Tuyeres and Cinder Notches.

The tuyeres illustrated are made of best bronze, each tuyere being fitted with an inlet water pipe, extending to the nose. A nipple made of gas pipe is screwed into the butt end, for the discharge.

BRONZE TUYERES.

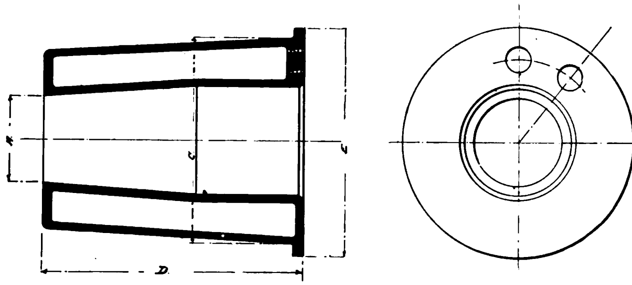


FIG. 55.

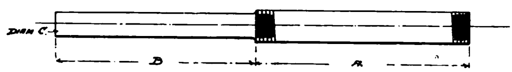


FIG. 56.

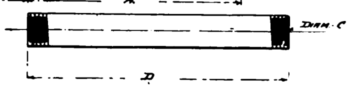


FIG. 57.

FEED AND DISCHARGE PIPES.

TABLE FOR TUYERES.

	A	B	C	D	E	PRICE.
Fig. 55.	4″	4⅞″	9½″	12″	10½″	
"	4½″	4⅞″	9½″	12″	10½″	
"	5″	6 1/16″	10¾″	12″	11¾″	
"	5½″	6 1/16″	10¾″	12″	11¾″	
"	6″	7⅛″	12″	12″	13″	
"	6½″	7⅛″	12″	12″	13″	
"	7″	8⅛″	13″	12″	14″	
"	7½″	8⅛″	13″	12″	14″	
"	4½″	5¼″	9¼″	12″	9 15/16″	

TABLE FOR "EXTRA" FEED AND DISCHARGE PIPES.

	A	B	C	D	E	PRICE.
56 & 57	12″	9¾″	1″	12″		

CINDER NOTCHES.

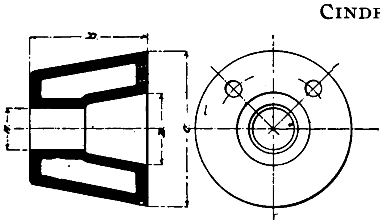


FIG. 58.

	A	B	C	D	PRICE.
Fig. 58.	1½″	2⅝″	5⅝″	4¼″	
"	2″	3″	6″	5″	

Pipe Coiled Tuyere and Cinder Arches.

The pipe coils for these arches can be made of 1″ or 1¼″ extra heavy gas pipe. In ordering, designate size of tuyere to be used and size of pipe wanted.

Tuyere Arches.

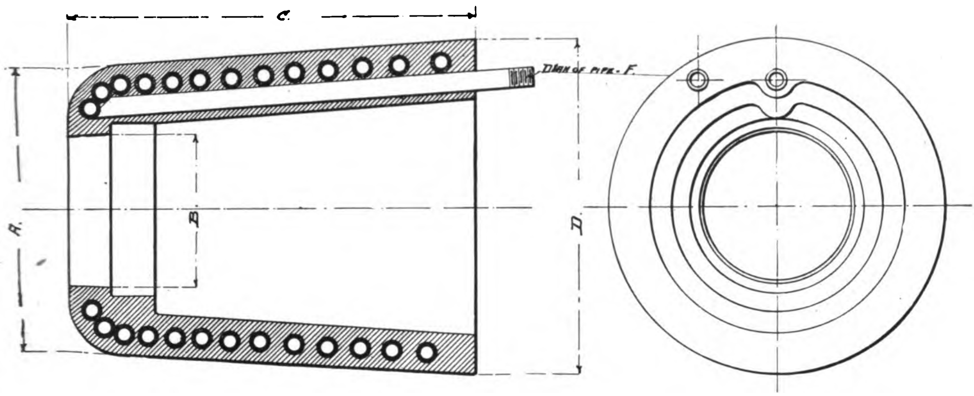


FIG. 59.

Table for Tuyere Arches.

For Tuyere Diameter.	A	B	C	D	E	Price.
4″ 4½″	19″	9¾″	25″	22½″	1″	
5″ 5½″	19″	11″	25″	22½″	1″	
6″ 6½″	21″	12¼″	27″	24½″	1″	
7″ 7½″	21″	13¼″	27″	24½″	1″	

Cinder Arches.

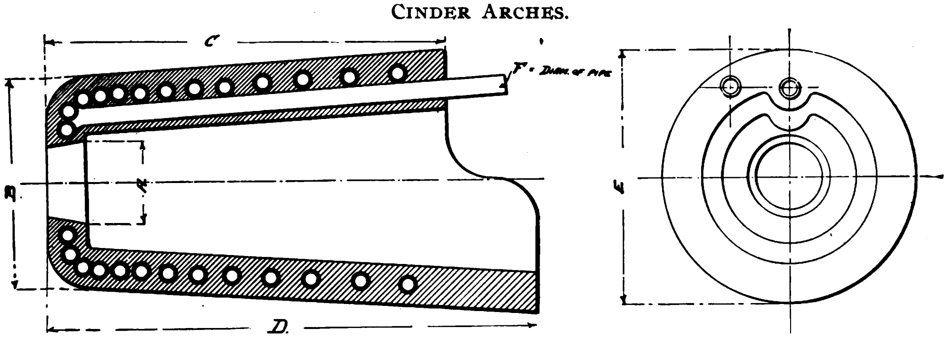


FIG. 60.

Table for Cinder Arches.

A	B	C	D	E	F	Price.
5⅝″	14″	27″	33″	12″	1″	
5⅝″	14″	32″	40″	12⅝″	1″	
8″	14″	27″	33″	12″	1″	
8″	14″	32″	40″	12⅝″	1″	

Pipe Coils for Tuyere and Cinder Arches.

To meet the wants of furnace companies situated at a remote point from iron foundries, we are prepared to furnish pipe coils for tuyere arches, enabling them to make their castings at the furnace if desired.

The coils given in the list can be made of ¾″, 1″ and 1¼″ extra strong gas pipe.

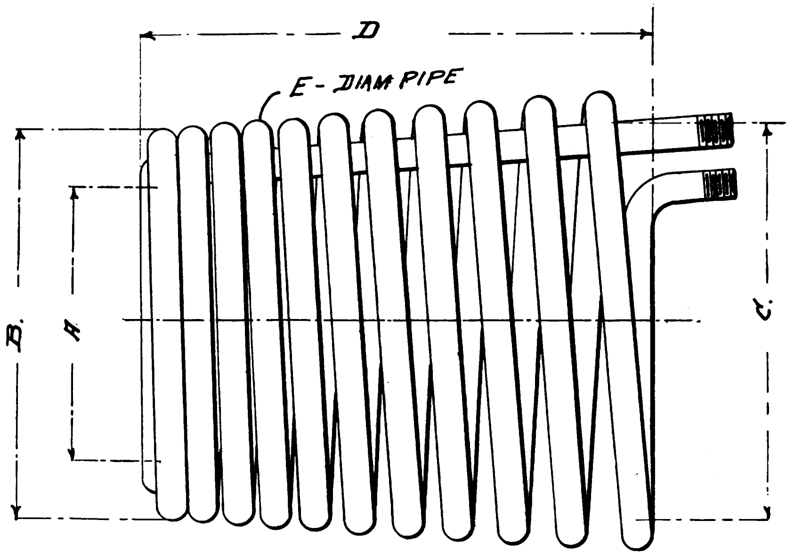


FIG. 61.

A	B	C	D	E	PRICE.
6¼″	10″	13⅛″	22″	1″	
11¼″	14⅞″	18⅜″	22″	1″	
12¼″	14⅞″	18⅜″	22″	1″	
13½″	16⅞″	20⅜″	24″	1″	
14⅜″	16⅞″	20⅜″	24″	1″	

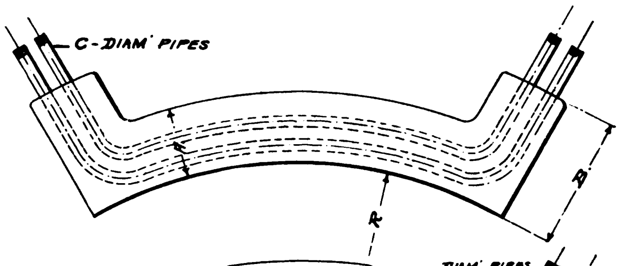
Pipe Coiled Bosh Cooling Plates.

For Furnace Walls.

Fig. 62 illustrates a plate provided with two independent pipes; *Fig. 63*, with a single pipe coiled with one return, or they can be made with any number of returns. The plate segments, for any diameters, can be made with 1″, 1¼″ and 1½″ extra heavy gas pipe.

Pipe Coiler Bosh Cooling Plates.

FIG. 62.



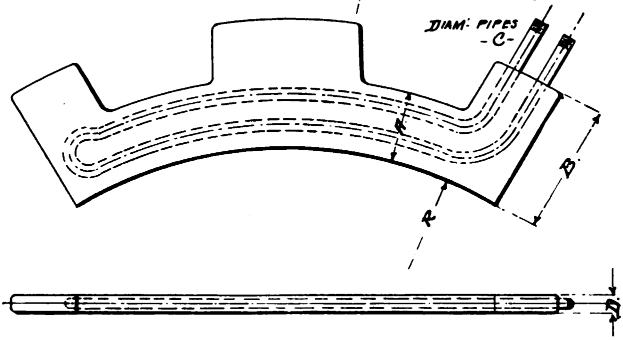


FIG. 63.

Cleaning and Explosion Doors.

For Descripton and List see Pages 77 and 78.

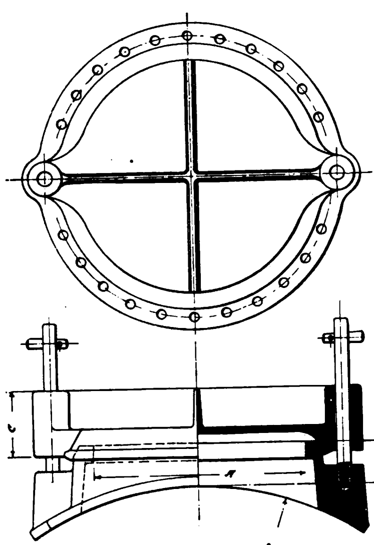


FIG. 73 A.

With Wrought Iron Mantel Beams.

Fig. 64 represents a mantel made of two wrought iron **I** beams, bent to any desired circle. A stiffening plate (*E*) is secured to the top of the beams. The beams are stayed latterly by cast iron distance blocks. The mantel represented in *Fig. 65* is composed of two channels and one eye beam, held together by a stiffening plate (*D*) on top, and braced latterly by cast iron distance blocks. We have a special tool by means of which we can bend **I** beams, channels, angles or tees to any desired radius, promptly, and shall be pleased to submit prices upon such work.

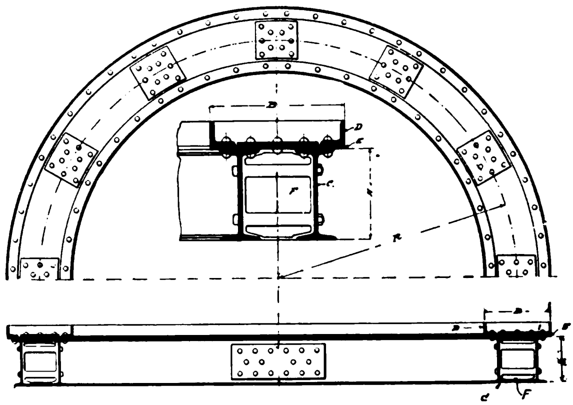


FIG. 64.

	A	B	C lbs.	D	E	F No.	R	PRICE.
Fig. 64.	10″	16½″	90	3″ x 3½″	½″	10	6′ 9″	
"	10″	16½″	90	3″ x 3½″	½″	10	7′ 3″	
"	12″	17″	130	3″ x 3½″	½″	12	7′ 9″	
"	12″	17″	130	3″ x 3½″	½″	12	8′ 2″	
"	12″	19″	130	4″ x 4″	⅝″	12	8′ 9″	
"	12″	19″	130	4″ x 4″	⅝″	12	9′ 3″	
"	12″	22″	130	4″ x 4″	⅝″	14	9′ 7″	
"	15″	24″	150	4″ x 4″	⅝″	14	10′ 3″	
"	15″	27″	150	5″ x 5″	¾″	14	10′ 7½″	
"	15″	27″	200	5″ x 5″	¾″	16	11′ 6″	

Wrought Iron Mantel Beams.

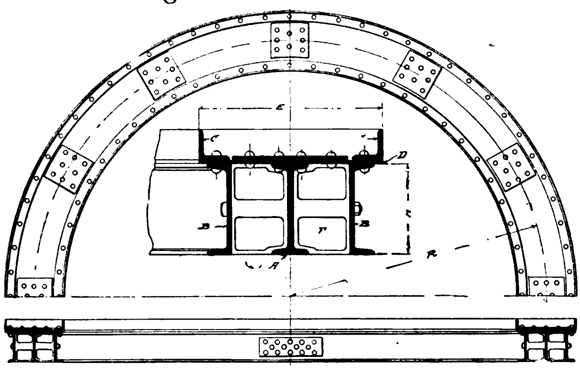


FIG. 65.

	A lbs.	B lbs.	C	D	E	F No.	R	H	PRICE.
Fig. 65.	200	260	5″ x 5″	¾″	30″	16	11′ 11″	15″	
"	200	260	5″ x 5″	¾″	33″	16	12′ 4″	15″	

Circular Feed Water Pipes.

The diameters of the pipes specified in lists may be slightly increased or diminished. The flanges are machined. A flat surface is cast upon one side of this pipe, thickening the same at that point so a large hole may be drilled and tapped into the same at any point.

In ordering, state whether with or without inlet on side of pipe, top or bottom.

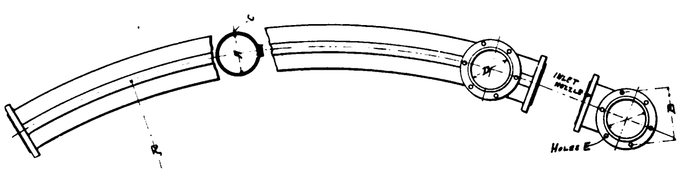


FIG. 66.

A	B	C	R	D	E	No. Segments.	PRICE.
4″	7″	½″	92″	4″	6-13/16″	Any	
5″	7½″	½″	84″	5″	6-13/16″	"	
6″	8½″	½″	99″	6″	6-13/16″	"	
7″	9½″	½″	113″	7″	6-13/16″	"	
7″	9½″	½″	117″	7″	6-13/16″	"	
7″	9½″	½″	110″	7″	6-13/16″	"	
6″	8½″	½″	139″	6″	6-13/16″	"	

Circular Water Troughs.

These troughs may be slightly increased or diminished in diameter. The flanges are machined.

In ordering, state whether with or without outlet nozzle.

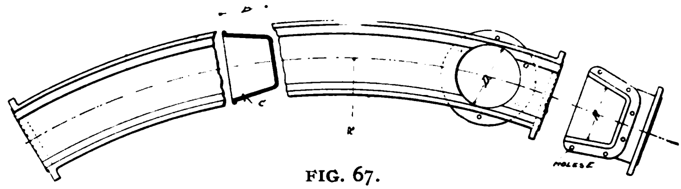


FIG. 67.

A	B	C	R	D	E	No. Segs.	PRICE.
7″	6″	½″	114″	8″	6-13/16″	Any	
7″	6″	½″	108″	8″	6-13/16″	"	
8″	7″	½″	126″	9″	6-13/16″	"	
8½″	8″	½″	149″	9″	6-13/16″	"	
10½″	9″	½″	145″	12″	6-13/16″	"	
10½″	9″	½″	140″	12″	6-13/16″	"	

Dust Catcher, Bell and Hopper.

Fig. 68 illustrates a bell and hopper, adapted for the base of a double legged dust catcher, as seen in *Fig. 2*, page 6. The bell is balanced by a weight suspended upon the operating lever. The bell also acts as an explosion door.

Fig. 70 illustrates a bell and hopper adapted for a cylindrical vertical pipe.

Fig. 71 illustrates the same type of bell and hopper as *Fig. 70*, but is provided with supporting columns.

The joints between bells and hopper are machined in each case, making them air tight.

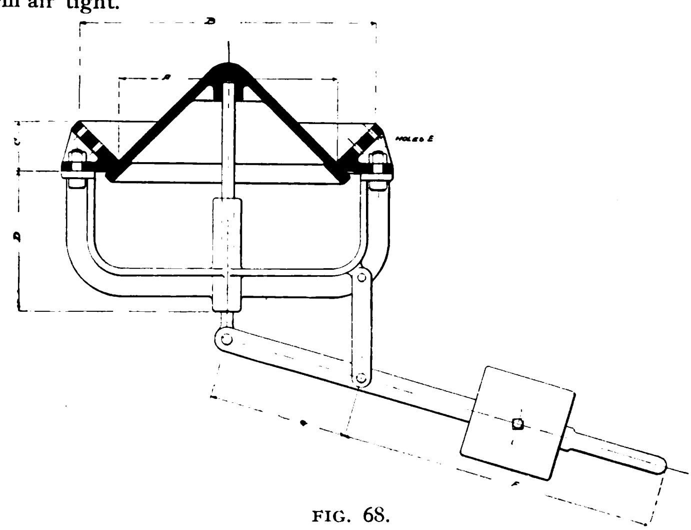


FIG. 68.

	A	B	C	D	E	F	G	PRICE.
Fig. 68.	23″	31″	5¼″	14¾″	⅝″	45″	15″	
"	18″	26″	5¼″	14¾″	⅝″	45″	13″	

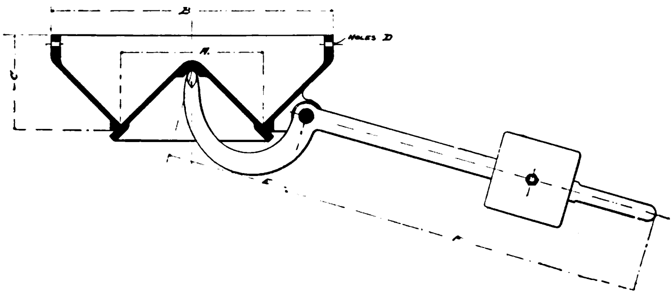


FIG. 70.

	A	B	C	D	E	F	PRICE.
Fig. 70.	18″	24¾″	6¾″	26-$\frac{11}{16}$″	14″	45½″	
"	18″	25¾″	6¾″	28-$\frac{11}{16}$″	15″	45½″	
"	18″	35¾″	11½″	38-$\frac{11}{16}$″	15″	45½″	
"	18″	39¾″	13½″	42-$\frac{11}{16}$″	15″	45½″	

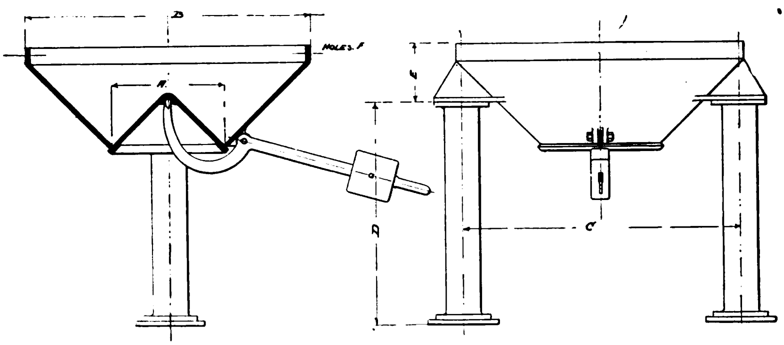


FIG. 71.

	A	B	C	D	E	F	PRICE.
Fig. 71.	18″	30″	31″	40½″	9″	19-$\frac{11}{16}$″	
"	18″	45″	45″	57″	16½″	$\frac{11}{16}$″-5″ cntrs	
"	24″	66″	64″	50″	23½″	$\frac{11}{16}$″-5″ cntrs.	

Bleeder Valves.

The valve proper is made heavy and of cast iron. It is machined, with a bevel seat, and fitted to a heavy valve ring. The lever is made of wrought iron.

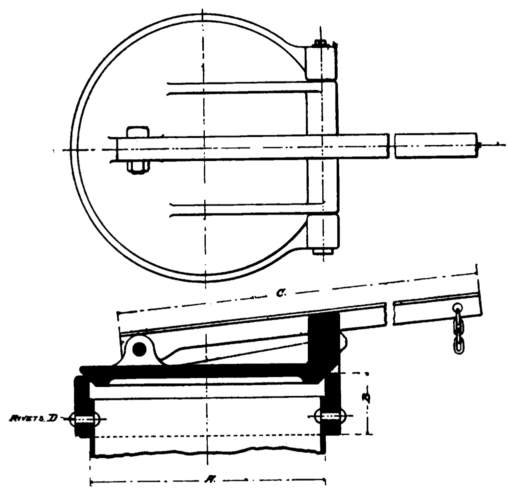


FIG. 72.

A	B	C	D	PRICE.
15½″	4¼″	60″	14-½″	
21⅜″	4½″	60″	19-½″	
24⅜″	4½″	60″	21-½″	
30¼″	4½″	87″	27-½″	

Cleaning and Explosion Doors.

FOR GAS MAINS, DOWN CORNER, ETC.

Fig. 73 illustrates circular doors. The surface between frame and door is machined. The door is hinged to the frame and is made heavy. The flanges can be made for circular or flat pipes.

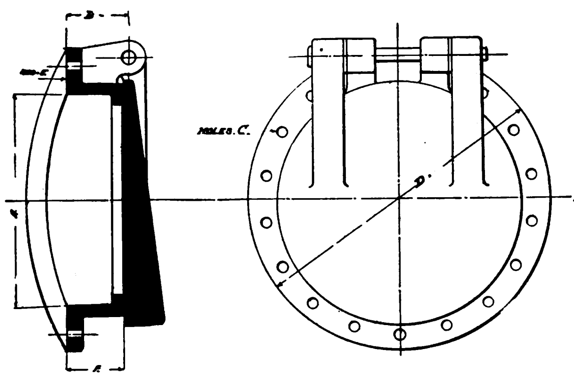


FIG. 73.

	A	B	C	D	E	F	PRICE.
Fig. 73.	15″	4″	18-⅝″	21½″	15¼″ to 33½″	4″	
"	8″	3″	10-⅝″	12⅜″	8″ to 12″	6″	

Fig. 73 *A*, page 71, illustrates another circular door, but is intended for horizontal pipes. The surface between frame and door is machined, with a tapering fit, the weight of the door holding it to its seat.

Figs. 74 and 75 illustrate square doors and frames, the former lying on the frame in an inclined position, its weight making a tight joint between the two machined surfaces. The flanges can be made for straight or circular pipes.

FIG. 73A. PAGE 71.

	A	B	C	D	R	PRICE.
Fig. 73A. Page 71.	20″	4″	6¼″	26-⅝″	21″ to 36″	

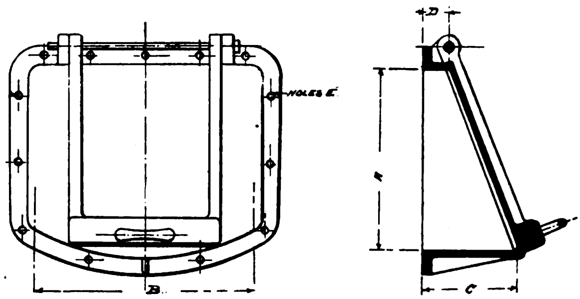


FIG. 74.

	A	B	C	D	E	F	PRICE.
Fig. 74.	20″	24″	10⅛″	2⅞″	14-⅝″	Straight flange.	

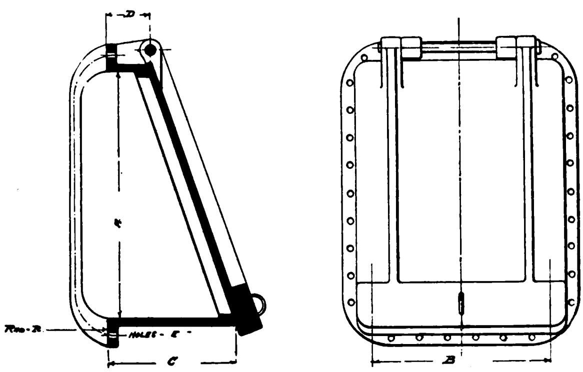


FIG. 75.

	A	B	C	D	E	R	PRICE.
Fig. 75.	30″	24″	16″	4½″	16-⅝″	$19\frac{3}{16}$″ $23\frac{3}{16}$″ $26\frac{3}{16}$″ $32\frac{3}{16}$″	

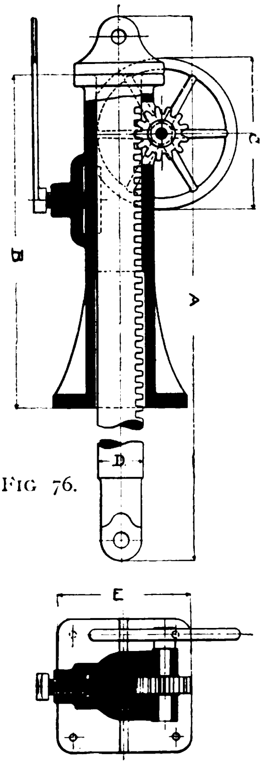


FIG 76.

Winch for Bells, etc.

The stand is cylindrical and bored out for a solid iron plunger.

A rack is cut in this plunger, which is lifted and lowered by means of a pinion and hand wheel. A brake pad and lever is provided, so the load may be lowered fast or slow.

Price . . . . . .

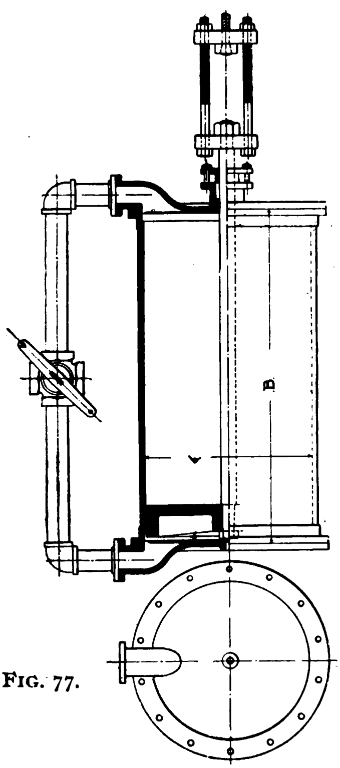


FIG. 77.

Air Cylinder for Bells, Valves, etc.

The cylinders are made of cast iron carefully bored out. The piston head is provided with sprung cast-iron packing rings. A turn-buckle is fitted to the end of piston rod, by means of which slack rope may be taken up or adjusted.

A 4-way cock is provided with pipe fittings to cylinder heads.

Price . . . . . .

Gas Escape Valves.

For Hot Blast Mains.

These valves are designed to carry off the gas which usually backs up from the furnace tuyeres to the hot blast main, when the blast is off. The valve being heavier than the levers, falls or opens when the blast is taken off, and is closed automatically when put on. The body is made heavy and is fitted to a saddle or neck, made to suit the radius of the pipe upon which it is to be placed.

In ordering, give diameter of this pipe.

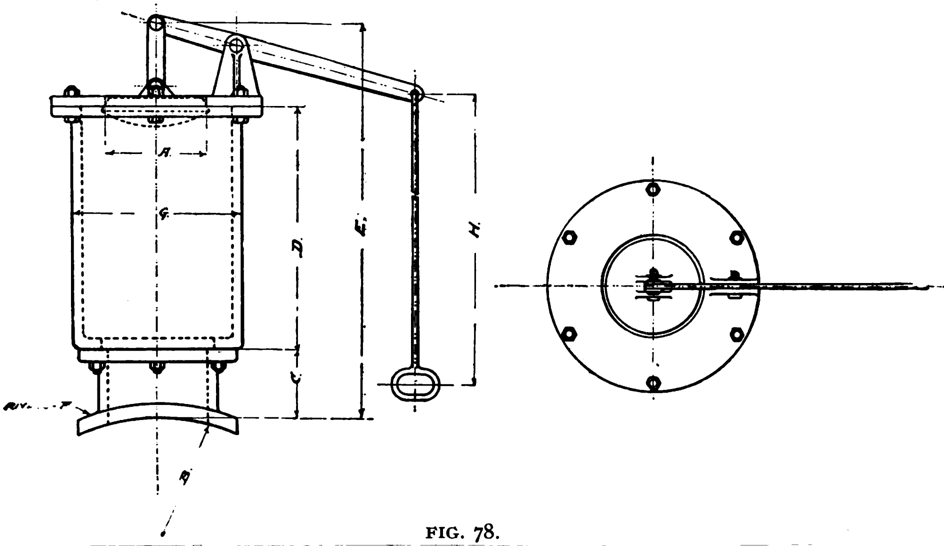


FIG. 78.

A	B	C	D	E	F	G	H	PRICE.
10″	15½″ to 23½″	6″	24″	40″	⅝″ 3½″ cntrs	16½″	123″	

Air Safety Valves.

These valves are made with either flat or curved flanges. The body is made of cast iron. The valve is fitted to the body with a bevelled seat. The lever is sufficiently long to weight the valve to 25 lbs. pressure or more.

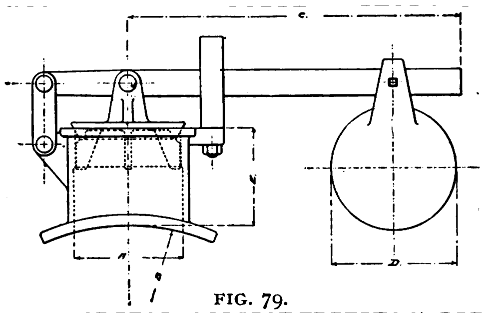


FIG. 79.

A	B	C	D	E	F	PRICE.
8″	10⅛″ to 19″	54″	9½″	6⅝″	Straight or Curved	
10″	18 to 36	54″	10¼″	6⅝″	"	

Air Relief or Snort Valves.

To avoid stopping the engines after casting, and yet cut off the blast from the furnace, the valve illustrated herewith is generally used. It is erected at a convenient point in the cold blast main, between the engines and hot blast stoves. When the main butterfly is closed the small one is opened on the pressure side to the atmosphere. An auxiliary or regulating butterfly valve is placed above the small one, by means of which the velocity of engines is uniformly maintained. The large and small butterflies are connected by a link, and both operated at once by means of a chain or rods extending close to the ground level.

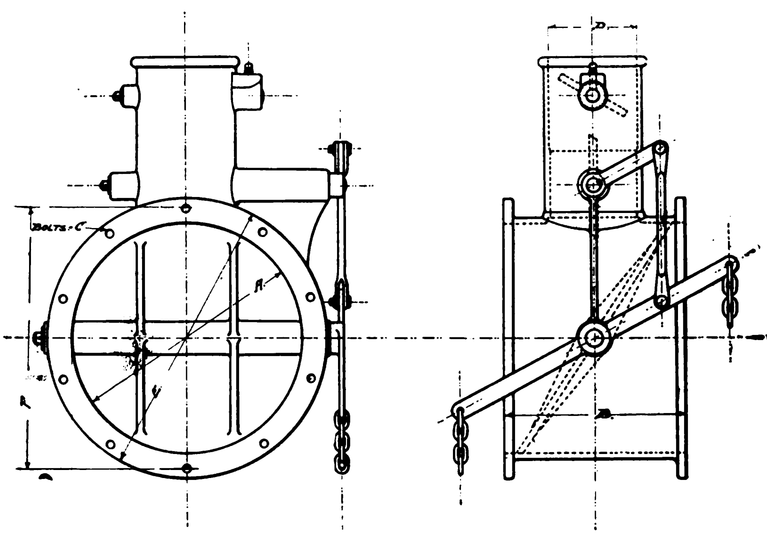


FIG. 80.

A	B	C	D	E	F	G	PRICE.
20″	16″	8-13/16″	9½″	25¾″	23¾″	27½″	
24″	19″	10-13/16″	9½″	29¾″	27¾″	29½″	
30″	19″	12-13/16″	12¾″	35¾″	33¾″	37″	
36″	22½″	12-13/16″	12¾″	43½″	41¼″	41″	

Reversing Butterfly Valves.

The body is made of cast iron, and is truly bored out. A butterfly valve is fitted in this body, provided with a shaft and lever. One side of the valve is made heavy so that it will always seat firmly.

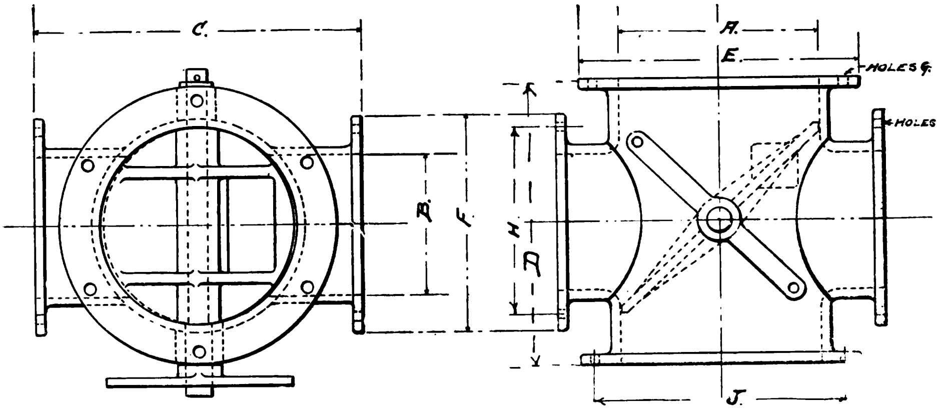


FIG. 81.

A	B	C	D	E	F	G	PRICE.
14″	10″	20″	20″	19¾″	15½″	16′-$\frac{11}{16}$″	

Reversing Valves.

FOR OPEN HEARTH FURNACES.

	A	B	C	D		PRICE.
Fig. 82.	24″	9′-0″	2′-11″	2′-1½″		

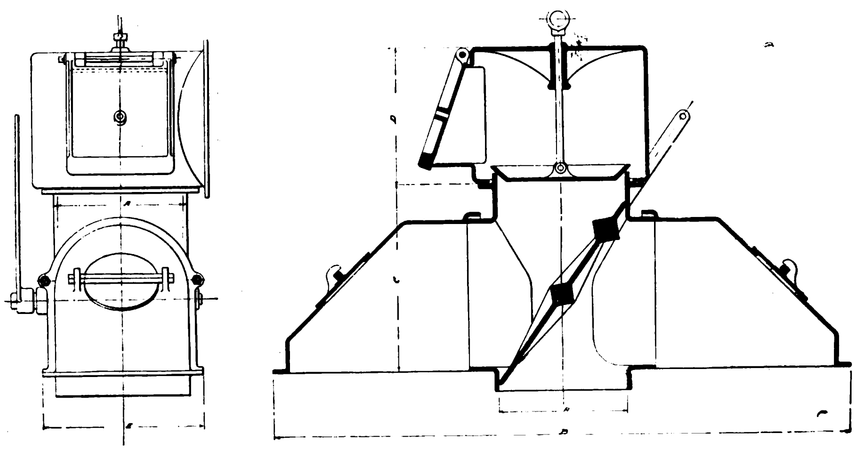


FIG. 82.

Gas Escape Valves.

For Regulating Pipes.

This valve is designed to carry off any gas accumulating in the pipe connecting the hot with the cold blast main. It is operated automatically. When the pressure is off, the valve rises to its upper seat, and when on is driven back to its lower seat.

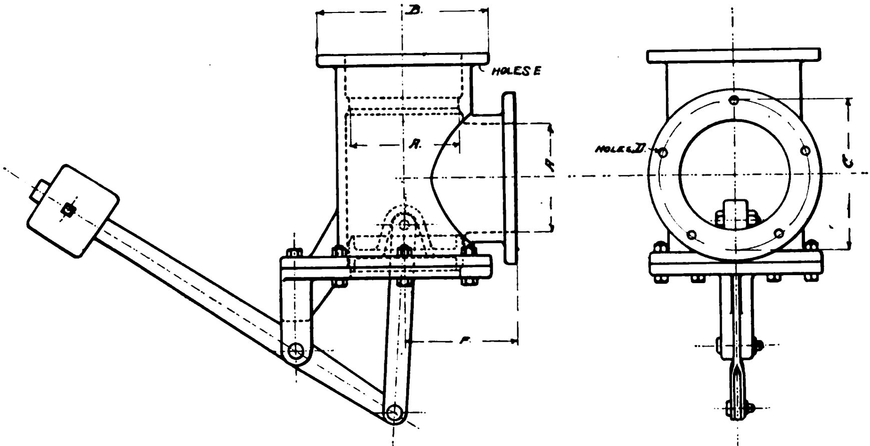


FIG. 83.

A	B	C	D	E	F	G	PRICE.
10″	13½″	13½″	5-1 3/16″	5-1 3/16″	10″	11¼″	

Clack or Gas Escape Valves.

This type of valve is designed to carry off the gas backing into hot blast mains from the furnaces when the blast is off. It is generally adopted for furnaces using pipe hot blast stoves. The valve is hinged to a detachable seat, the points of contact being machined. It is nearly balanced by a weight suspended on a lever. When the pressure is removed it falls by gravity to a seat on the body, thereby permitting the backing gas to escape through the opening in the detachable seat to the atmosphere. The valve throughout is made very heavy to overcome warpage.

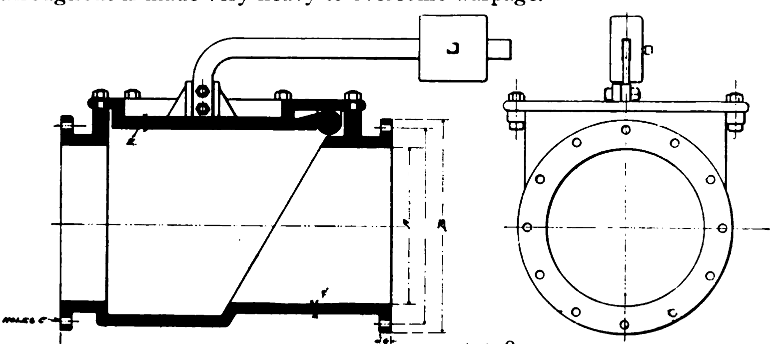


FIG. 84.

A	B	C	D	E	F	G	PRICE.
20″	27¼″	12-1 3/16″	42″	1½″	1¼″	1½″	

Standard Pipe Flanges.

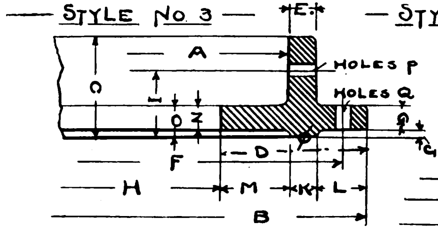


FIG. 85.

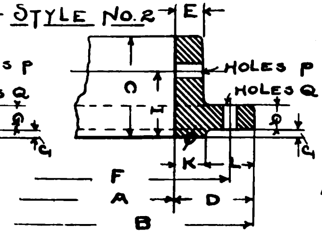


FIG. 86.

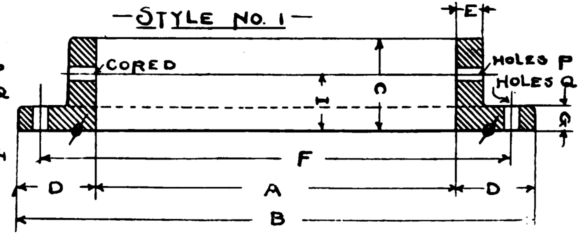


FIG. 87.

STANDARD FLANGES.

After July 24, 1890.

Card No.	Pattern No	Style No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	HOLES P. No. in Circle.	HOLES P. Diameter of Rivet.	HOLES Q. No. in Circle	HOLES Q. Bolt Diameter	
1	2840	3	36½″	43″	4¼″	6½″	1″	41″	1⅜″	30″	3⅛″	⅛″	1¼″	2¼″	3″	1″	1⅜″	36	⅝″	12	¾″	
2	2841	2	36″	43″	4¼″	3½″	1″	41″	1⅜″	. . .	3⅛″	⅛″	1¼″	2¼″	. .	. .	. . .	36	⅝″	12	¾″	
3	2696	3	40½″	47″	4¼″	6½″	1″	45″	1⅜″	34″	3⅛″	⅛″	1¼″	2¼″	3″	1″	1⅜″	36	⅝″	12	¾″	
4	2697	2	40″	47″	4¼″	3½″	1″	45″	1⅜″	. . .	3⅛″	⅛″	1¼″	2¼″	. .	. .	. . .	36	⅝″	12	¾″	
5	2730	3	42¼″	49½″	4¼″	6½″	1″	47½″	1⅜″	36½″	3⅛″	⅛″	1¼″	2¼″	3″	1″	1⅜″	42	⅝″	14	¾″	
6	2731	2	42¼″	49½″	4¼″	3½″	1″	47½″	1⅜″	. . .	3⅛″	⅛″	1¼″	2¼″	. .	. .	. . .	42	⅝″	14	¾″	
7	3018	1	18¼″	23¾″	3″	2¾″	¾″	21¾″	⅞″	. . .	2″	. .	. .	. .	. .	. .	. . .	24	½″	8	⅝″	
9	3024	1	10″	15½″	3″	2¾″	¾″	13½″	⅞″	. . .	2″	. .	. .	. .	. .	. .	. . .	15	½″	5	⅝″	
10	205	1	20¼″	25¾″	3″	2¾″	¾″	23¾″	⅞″	. . .	2″	. .	. .	. .	. .	. .	. . .	24	½″	8	⅝″	
11	202	1	17⅜″	22⅞″	3″	2¾″	¾″	20⅞″	⅞″	. . .	2″	. .	. .	. .	. .	. .	. . .	21	½″	7	⅝″	
12	2930	1	15¼″	20¾″	3″	2¾″	¾″	18¾″	⅞″	. . .	2″	. .	. .	. .	. .	. .	. . .	18	½″	6	⅝″	
14	2964	1	36½″	43½″	3″	3½″	⅞″	41¼″	⅞″	. . .	2″	. .	. .	. .	. .	. .	. . .	36	½″	12	⅝″	Special.
15	2280	1	24¼″	29¾″	3″	2¾″	¾″	27¾″	⅞″	. . .	2″	. .	. .	. .	. .	. .	. . .	30	½″	10	⅝″	

Standard Flanges.

Card No.	Pattern No.	Style No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Holes P. No. in Circle.	Holes P. Diameter of Rivet.	Holes Q. No. in Circle.	Holes Q. Bolt Diameter	
16	3035	1	16½''	22''	3''	2¾''	¾''	20''	⅞''	...	2''	...	...	...	...	...	...	21	½''	7	⅝''	
17	2290	1	20¼''	29¼''	3''	4½''	¾''	27¼''	⅞''	...	2''	...	...	...	...	...	...	24	½''	8	⅝''	Special.
19	211A	1	26¼''	31¾''	3''	2¾''	¾''	29¾''	⅞''	...	2''	...	...	...	...	...	...	30	½''	10	⅝''	
21	2280	1	24¼''	29¾''	3''	2¾''	¾''	27¾''	⅞''	...	2''	...	...	...	...	...	...	30	½''	10	⅝''	
23	19A	1	22''	27½''	3''	2¾''	¾''	25½''	⅞''	...	2''	...	...	...	...	...	...	24	½''	8	⅝''	
25	3138	1	28½''	36½''	4½''	4''	1¼''	34''	1½''	...	3''	...	...	...	...	...	...	21	¾''	7	1''	Special.
27	3151	1	61½''	69½''	4½''	4''	1⅛''	66½''	1¼''	...	3⅛''	...	...	...	...	...	...	64	⅝''	32	¾''	Special.
28	3152	1	45½''	53½''	4½''	4''	1⅛''	50½''	1¼''	...	3⅛''	...	...	...	...	...	...	48	⅝''	24	¾''	
34	2286	1	26¼''	31¾''	3''	2¾''	¾''	29¾''	⅞''	...	2''	...	...	...	...	...	...	30	½''	10	⅝''	
35	2731A	1	42¼''	49¼''	4''	3½''	1''	47''	1¼''	...	2¾''	...	...	...	...	...	...	42	⅝''	14	¾''	
43	215	1	30¼''	35¾''	3''	2¾''	¾''	33¾''	⅞''	...	2''	...	...	...	...	...	...	36	½''	12	⅝''	Jefferson Special.
54	2697A	3	40''	47''	4¼''	3½''	⅞''	45''	1⅜''	34''	3⅛''	⅛''	1¼''	2¼''	3''	1''	1⅜''	36	⅝''	12	¾''	Special.
55	198	1	22''	27⅞''	3''	2 15/16''	¾''	25⅞''	⅞''	...	2''	...	...	...	...	...	...	24	½''	8	¾''	Special.
56	3138A	1	28½''	40''	4½''	5¾''	1¼''	...	1½''	...	3''	...	...	...	...	...	...	21	¾''			No Pat. Sweep.
57	3261	1	21¾''	29¾''	3''	4''	¾''	27¾''	⅞''	...	2''	...	...	...	...	...	...	24	½''	10	⅝''	
67	...	1	28¼''	33¾''	3''	2¾''	¾''	31¾''	⅞''	...	2''	...	...	...	...	...	...	33	½''	11	⅝''	Special 30'' Short Valve.
86	215	1	30¼''	35¾''	3''	2¾''	¾''	33¾''	⅞''	...	2''	...	...	...	...	...	...	36	½''	12	¾''	
90	3334	1	14¼''	19¾''	3''	2¾''	¾''	17¾''	⅞''	...	2''	...	...	...	...	...	...	18	½''	6	⅝''	
91	3335	1	12⅛''	18''	3''	2 15/16''	¾''	16''	⅞''	...	2''	...	...	...	...	...	...	15	½''	5	⅝''	With Lugs.
103	2840A	3	36''	43''	4¼''	6½''	1¼''	41''	1⅜''	30''	3⅛''	⅛''	1¼''	2¼''	3''	1''	1⅜''	36	⅝''	12	¾''	With Lugs.
104	2841A	2	35½''	43''	4¼''	3½''	1¼''	41''	1⅜''	...	3⅛''	⅛''	1¼''	2¼''	...	...	...	36	⅝''	12	¾''	Without Lugs
105	2697A	1	40''	47''	4¼''	3½''	1''	45''	1¼''	...	3⅛''	⅛''	1¼''	2¼''	...	...	...	36	⅝''	18	¾''	Special Reducing.
108	6	1	27¼''	35¾''	3''	4¼''	¾''	33¾''	⅞''	...	2''	...	...	...	...	...	...	33	½''	12	⅝''	
110	6A	1	27¼''	32¾''	3''	2¾''	¾''	30¾''	⅞''	...	2''	...	...	...	...	...	...	33	½''	11	⅝''	
111	3018A	1	18¼''	36''	3''	8⅞''	¾''	...	⅞''	...	2''	...	...	...	...	...	...	24	½''	...	...	
115	3603	1	33½''	40''	4''	3¼''	1''	37¾''	1¼''	...	2¾''	...	...	...	...	...	...	30	11/16''	34	⅞''	
118	2280A	1	24¼''	29¾''	3''	2¾''	¾''	27¾''	⅞''	...	2''	...	...	...	...	...	...	28	⅝''	14	¾''	
119	205A	1	20½''	25¾''	3''	2¾''	¾''	23¾''	⅞''	...	2''	...	...	...	...	...	...	24	½''	8	⅝''	
121	3151A	1	61½''	69½''	4½''	4''	1⅛''	66½''	1¼''	...	3⅛''	...	...	...	...	...	...	56	⅝''	32	¾''	

Elbows.

For Cold Blast Valves, and Other Purposes.

FIG. 88. FIG. 89. FIG. 90. FIG. 91. FIG. 92.

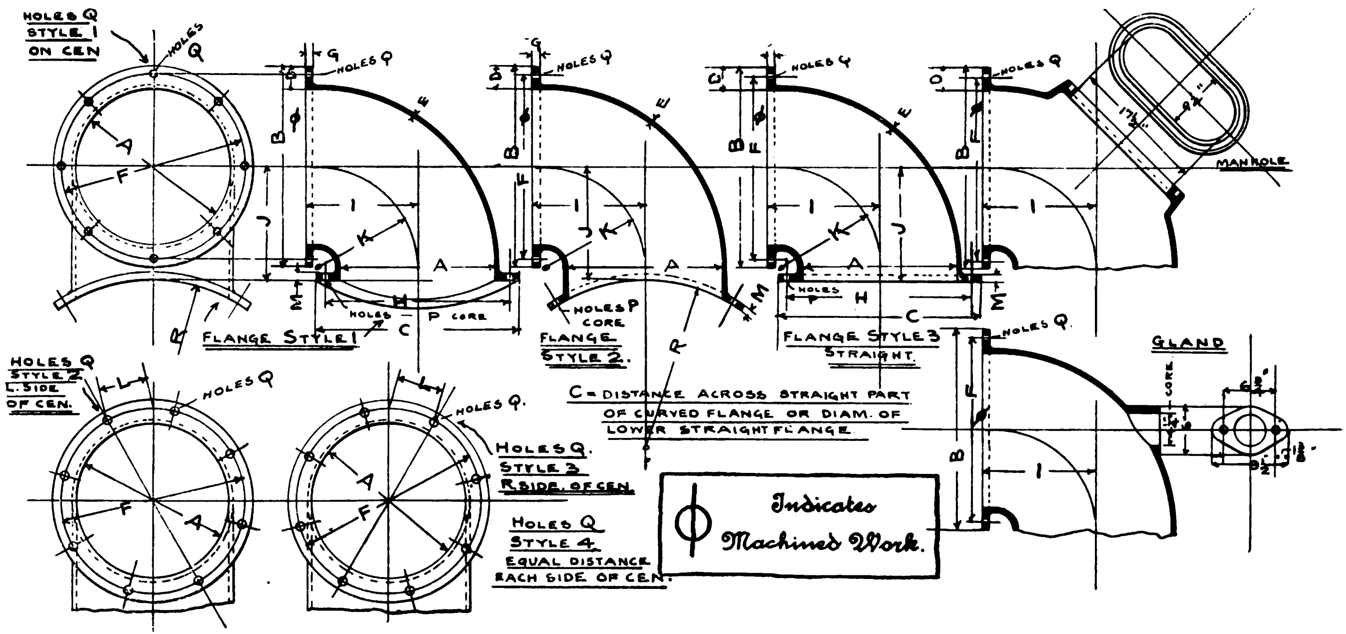


FIG. 93. FIG. 94. FIG. 95.

	Card No.	Pattern No.	Flange Style.	Manhole.	Gland.	A	B	C	D	E	F	G	H	I	J	K	L	M	R	HOLES P. No. in Circle.	HOLES P. Diameter of Rivet.	Style.	HOLES Q. No. in Circle.	HOLES Q. Bolt Diameter.	Replaces Card.
	68	36	1	. .	. .	17″	22⅞″	23″	2 15/16″	½″	20⅞″	⅞″	20½″	13″	13″	. .	. .	⅞″	7′ 9″	18	⅝″	.	7	⅝″	1
	69	36A	1	. .	. .	17″	22⅞″	23″	2 15/16″	½″	20⅞″	⅞″	20½″	13″	13″	. .	. .	⅞″	21½″	18	⅝″	.	7	⅝″	8
	70	96	1	. .	. .	20″	25¾″	26″	2⅞″	½″	23¾″	⅞″	23½″	14½″	14½″	. .	. .	⅞″	7′ 9″	20	⅝″	.	8	⅝″	2
	71	2826	1	. .	. .	20″	25¾″	26″	2⅞″	½″	23¾″	⅞″	23½″	14½″	14½″	. .	. .	⅞″	21½″	20	⅝″	.	8	⅝″	21
	72	97	1	. .		22″	27½″	28″	2¾″	½″	25½″	⅞″	25½″	15½″	15½″	. .	. .	⅞″	7′ 9″	22	⅝″	.	8	⅝″	3
Special Heavy.	73	97A	2	. .		22″	27⅞″	28″	2 15/16″	½″	25⅞″	1⅛″	25½″	15½″	15½″	. .	. .	1⅛″	30¾″	22	⅝″	.	8	¾″	19
Special	74	784	3	with	. .	23¼″	28″	28″	2⅜″	¾″	26¼″	¾″	26¼″	16½″	16½″	. .	. .	¾″	. . .	. .	. .	.	. .	. .	13
	75	98	1	. .	. .	24″	29¾″	30¼″	2⅞″	⅝″	27¾″	⅞″	27¼″	16½″	16½″	. .	. .	⅞″	10′ 0″	24	⅝″	.	10	⅝″	4
	76	98A	1	. .	. .	24″	29¾″	30¼″	2⅞″	⅝″	27¾″	⅞″	27¼″	16½″	16½″	. .	. .	⅞″	28″	24	⅝″	.	10	⅝″	9
Special.	77	82	2	. .	. .	24″	30½″	30¼″	3¼″	⅝″	29″	1″	27¼″	16¼″	16⅜″	. .	1⅞″	1⅛″	19¼″	24	⅝″	3	8	¾″	10
Special.	78	82A	2	. .	. .	24″	30½″	30¼″	3¼″	⅝″	29″	1″	27¼″	16¼″	16⅜″	. .	1⅞″	1⅛″	20¼″	24	⅝″	3	8	¾″	11
Special.	79	82B	2		. .	24″	30½″	30¼″	3¼″	⅝″	29″	1″	27¼″	16¼″	16⅜″	.	1⅞″	1⅛″	21¼″	24	⅝″	3	8	¾″	12
	80	99	1	. .	. .	26″	31¾″	32¼″	2⅞″	⅝″	29¾″	⅞″	29¾″	17½″	17½″	. .	. .	⅞″	10′ 0″	26	⅝″	.	10	⅝″	5
Special.	81	99A	3	. .	with	26″	31¾″	31½″	2⅞″	⅝″	29¾″	⅞″	29¼″	17½″	17½″	. .	. .	⅞″	. . .	10	¾″	4	10	⅝″	15
	82	99B	1	. .	. .	26″	31¾″	32¼″	2⅞″	⅝″	29¾″	⅞″	29¾″	17½″	17½″	. .	. .	1″	29″	26	⅝″		10	⅝″	20
	83	100	1		. .	28″	33¾″	34¼″	2⅞″	⅝″	31¾″	⅞″	31¾″	18½″	18½″	. .	. .	⅞″	10′ 0″	28	⅝″	.	11	⅝″	6
	84	101	1	. .	. .	30″	35¾″	36¼″	2⅞″	⅝″	33¾″	⅞″	33¾″	19½″	19½″	. .	. .	⅞″	10′ 0″	29	⅝″	.	12	⅝″	7
	85	3230	2	. .	. .	11″	17″	15½″	3″	½″	14½″	1″	14¼″	14¼″	2′-8″	12″	. .	1″	14¼″	13	⅝″	.	6	¾″	22
	92	2595	3	. .	. .	7″	12″	12″	2½″	¾″	10″	1″	10″	9″	9″	7″	. .	1″	. . .	6	⅞″	.	6	⅞″	. .
	93	2592	3	. .	. .	5″	10″	10″	2½″	¾″	8″	1″	8″	8″	8″	6″	. .	1″	. . .	6	⅞″	.	6	⅞″	. .
Special Heavy.	113	988	1	. .	. .	24″	29¾″	30½″	2⅞″	¾″	27¾″	1″	28″	2′-3″	2′-3″	. .	. .	1½″	9′ 0″	28	¾″	1	11	¾″	Blue 09

Saddle Flanges.

FIG. 96. FIG. 97. FIG. 98.

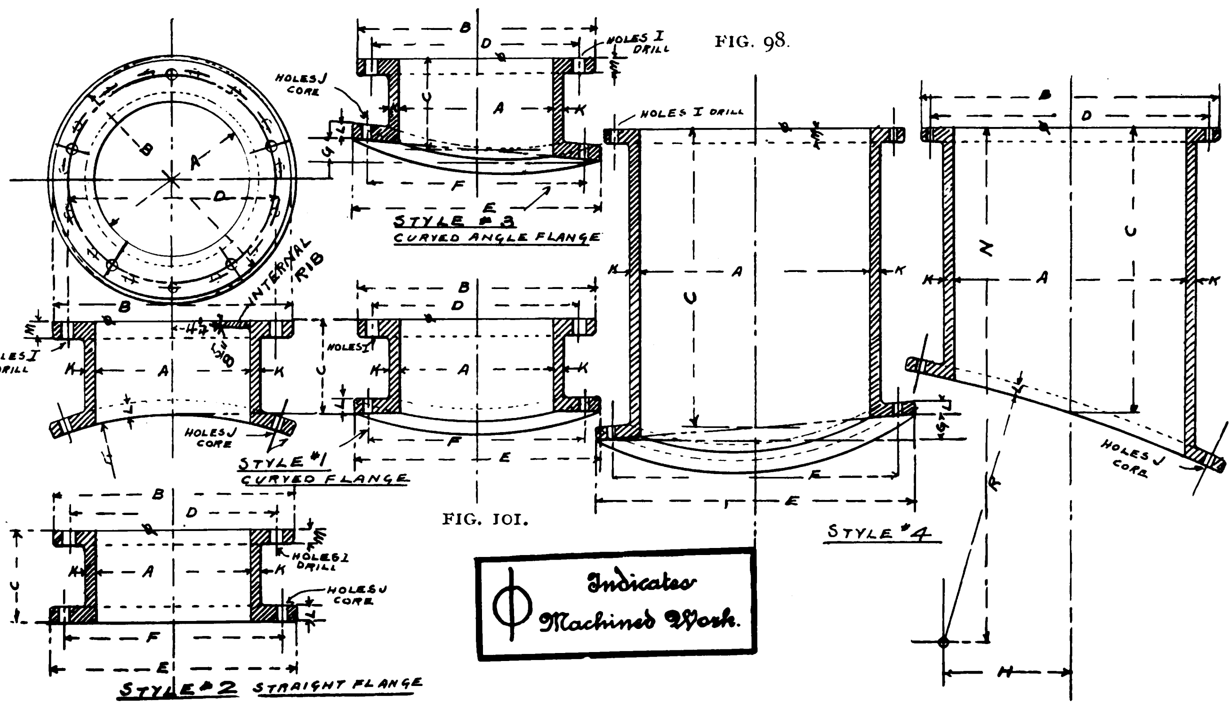


FIG. 100. FIG. 101. FIG. 99.

Card	Pattern No.	Style	A	B	C	D	E	F	G	H	Holes I. No. in Circle.	Holes I. Diameter of Bolt.	Holes J. No. in Circle.	Holes J. Diameter of Rivet.	K	L	M	R	N	Right or Left.	Internal Rib.
39	1940	1	10″	15½″	6″	13½″	...	...	...	...	5	⅝″	15	½″	⅝″	1″	1″	12⅛″	...	...	Out
40	1940A	1	10″	15½″	6″	13½″	...	...	...	...	5	⅝″	15	½″	⅝″	1″	1″	21″	...	...	Out
47	240	1	10″	15½″	6″	13½″	16″	...	...	...	6	⅝″	...	...	¾″	1″	1″	15½″	...	...	Out
48	241	1	10″	15½″	6″	13½″	16″	...	...	...	6	⅝″	...	...	¾″	1″	1″	17½″	...	...	Out
49	242	1	10″	15½″	6″	13½″	16″	...	...	...	6	⅝″	...	...	¾″	1″	1″	19½″	...	...	Out
50	243	1	10″	15½″	6″	13½″	16″	...	...	...	6	⅝″	...	...	¾″	1″	1″	21½″	...	...	Out
51	244	1	10″	15½″	6″	13½″	16″	...	...	...	6	⅝″	...	...	¾″	1″	1″	23½″	...	...	Out
44	3242	1	15″	19¼″	8″	18¼″	20¾″	18¼″	...	...	8	⅝″	17	½″	⅝″	1″	⅞″	8′0″	...	...	Out
45	3243	3	15″	19¼″	8″	18¼″	20¾″	18¼″	1½″	...	8	⅝″	17	½″	⅝″	1″	⅞″	8′0″	...	...	Out
46	3244	4	15″	19¼″	18½″	18¼″	20¾″	18¼″	1½″	2′4½″	8	⅝″	17	½″	⅝″	1″	⅞″	7′6″	8′8″	R. H.	Out
52	3244A	4	15″	19¼″	18½″	18¼″	20¾″	18¼″	1½″	2′4½″	8	⅝″	17	½″	⅝″	1″	⅞″	7′6″	8′8″	L. H.	Out
87	2143	1	12″	18″	7¼″	...	...	...	...	...	...	⅝″	...	½″	¾″	1⅛″	1⅛″	18″	...	...	Out
88	2143A	1	12″	18″	7″	...	...	...	...	...	...	⅝″	...	½″	¾″	1″	1″	25″	...	...	Out
109	3519	1	12½″	19″	4¼″	16¾″	19¼″	16¾″	...	...	10	¾″	21	⅝″	⅞″	1″	1″	18½″	...	...	With
114	3602	1	33″	40″	7″	37¾″	40½″	37¾″	...	...	34	⅞″	34	¾″	1″	1½″	1¼″	9′0″	...	...	Out
116	3604	1	18″	26″	9″	23½″	25½″	23″	...	...	6	¾″	21	11/16″	1″	1½″	1¼″	2′6″	...	...	Out
117	3605	1	20″	25¾″	8″	23¾″	26″	24″	...	...	8	⅝″	23	⅝″	¾″	1¼″	1″	29⅜″	...	...	Out

Sliding Hot Blast Valves.

OPERATED IN A HORIZONTAL POSITION.

The bodies are made of cast iron bolted between a pair of heavy cast iron flanges. The valve seats are heavy cast iron rings, machined on both sides and coursed with two circles of 1″ gaspipe. The seat is bolted between machined surfaces of the valve body and flanges. It can be removed without disturbing the brick lining in the hot blast mains. The valves are heavy castings coursed with 1″ gaspipe. A rack is cut in the stem, in which a pinion works. The pinion, shaft and operating hand wheels are held in place by brackets, bolted to the valve caps.

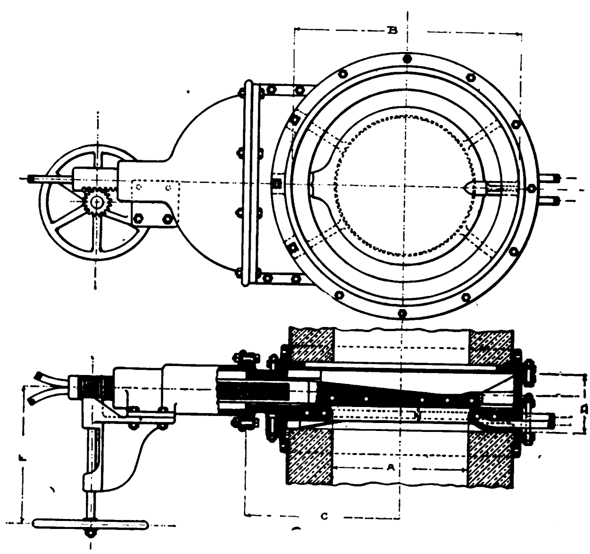


FIG. 102.—HOT BLAST VALVES.

A	B	C	D	E	F	PRICE.
20″	36″	22¾″	10¼″	4¼″	24″	
24″	40″	27″	10¼″	4¼″	24″	
26″	42″	28¼″	10¼″	4¼″	24″	

Sliding Hot Blast Valves.

OPERATED IN A VERTICAL POSITION.

The bodies are made of cast iron, bolted between a pair of iron flanges. The valve seats are heavy cast iron rings, machined on both sides and coursed with two circles of 1″ gaspipe. They can be removed without disturbing the body or brick lining. The valves are thick castings coursed with 1″ gaspipe.

The valves are actuated by means of a pair of link bars, secured at one end to the top of the valve stem, and at the other end to a pair of levers pivoted upon a fulcrum, cast to the cap of the valve. Upon the outer end of these levers is bolted a cast iron counter weight of sufficient size to properly balance the valve. By this arrangement the operation of opening and closing the valve is done quickly and positively.

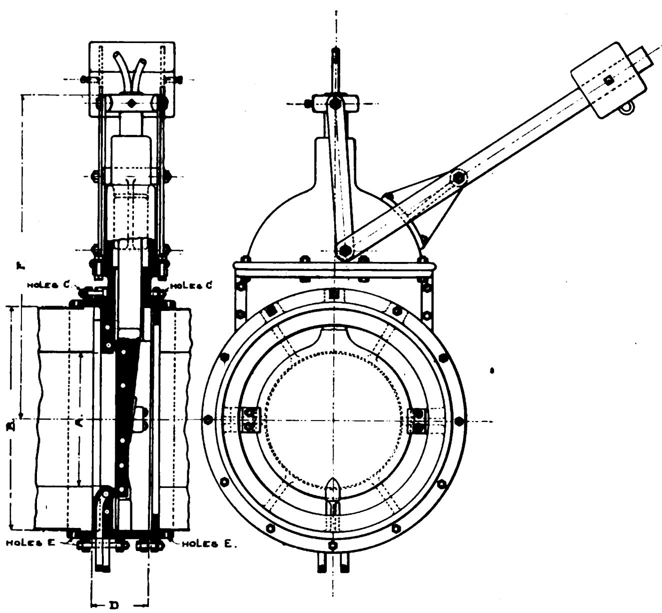
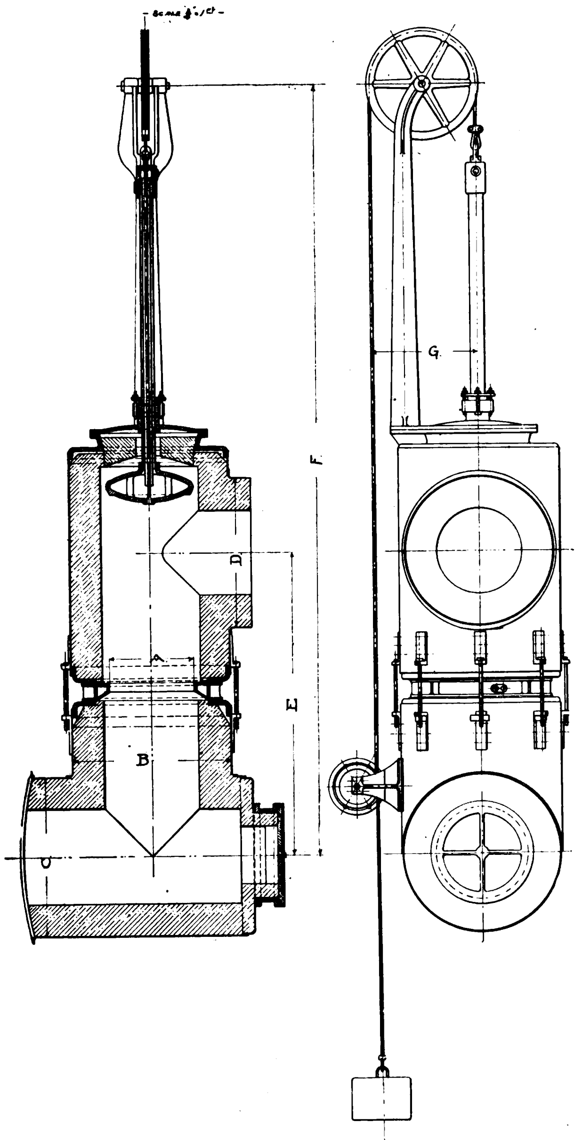


FIG. 103.

A	B	C	D	E	F	PRICE.
24″	40″		10¼″		58″	
26″	42″		10¼″		63″	

Puppet Hot Blast Valves.

WITH BERG VALVE SEAT.



The seats are made of bronze and are hollow. They can be removed readily without disturbing the brickwork.

The valve stems are made of seamless drawn tubing.

The cap is made small and can be removed without disturbing the sheave post and sheave, ensuring a convenient and quick method of withdrawing the valve proper should it be necessary to examine or replace the same.

Prices submitted upon any diameter.

FIG. 104.

Puppet Hot Blast Valves.

The valve casings are made of plate iron and are provided with a flanged plate steel branch. The valve seats can be made of cast iron or bronze, and are bolted between cast iron flanges riveted to the inside of the casings. By this plan the seat may be removed quickly and replaced, without disturbing the brickwork. The valve is of the hollow puppet form. A seamless drawn brass valve stem is bolted to this valve, and is provided with feed and discharge waterpipe connections.

The upper head is spherical in form, made heavy, and provided with a stem guide. A cast iron sheave stand and sheave shafts are fitted to this head.

A wire rope connects the valve and counter weight, making 1½ turns around the rope sheave. This sheave is operated by means of a chain working in sprocket wheels, the lower one being provided with a hand wheel.

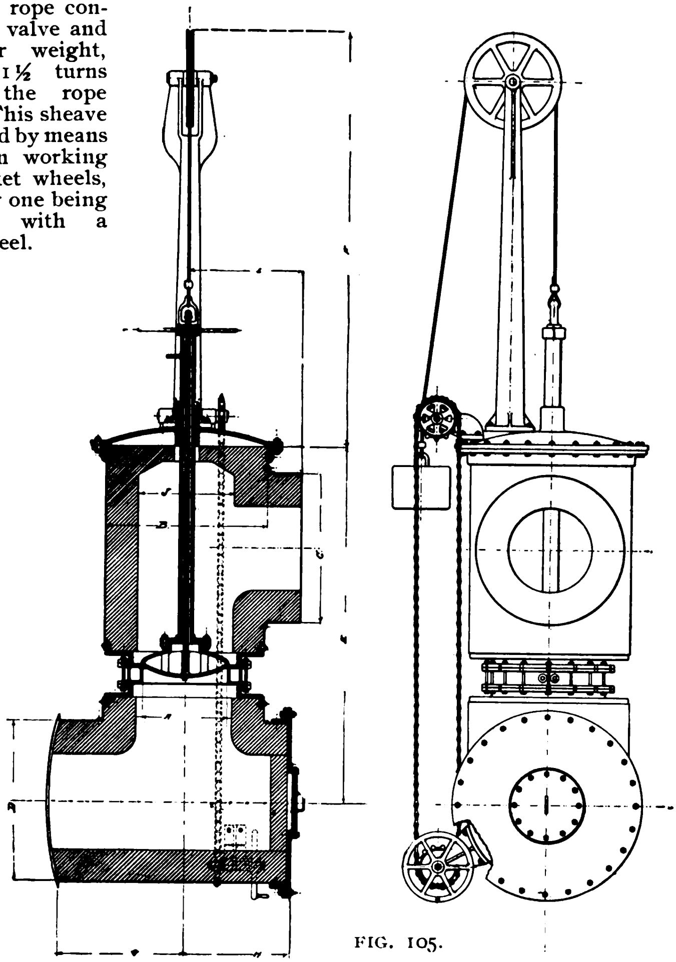


FIG. 105.

	A	B	C	D	E	F	G	H	I	J	PRICE.
Fig. 105.	24″	45″	42″	45″	8′ 4″	9′ 9″	34½″	30″	32½″	28″	
“ *104*	24″	45″	45″	42″							

Puppet Chimney Valves.

The valve casings are made of plate iron, a heavy cast iron flange being riveted to each end. The valve seats are made of cast iron coursed with 1″ extra thick pipe. The valves are of the puppet form and made of cast iron. Seamless drawn brass stems are bolted to the valves, each being provided with feed and discharge waterpipes.

The heads are spherical in shape, a valve stem guide being cast upon the same. Sheave stands are bolted to the heads, to which are fitted rope sheaves. Wire ropes connect the valves and counter weights.

The valves are raised and lowered by means of a chain working in sprocket wheels, the lower one being provided with a hand wheel. A manhole frame and lid is riveted to the casing.

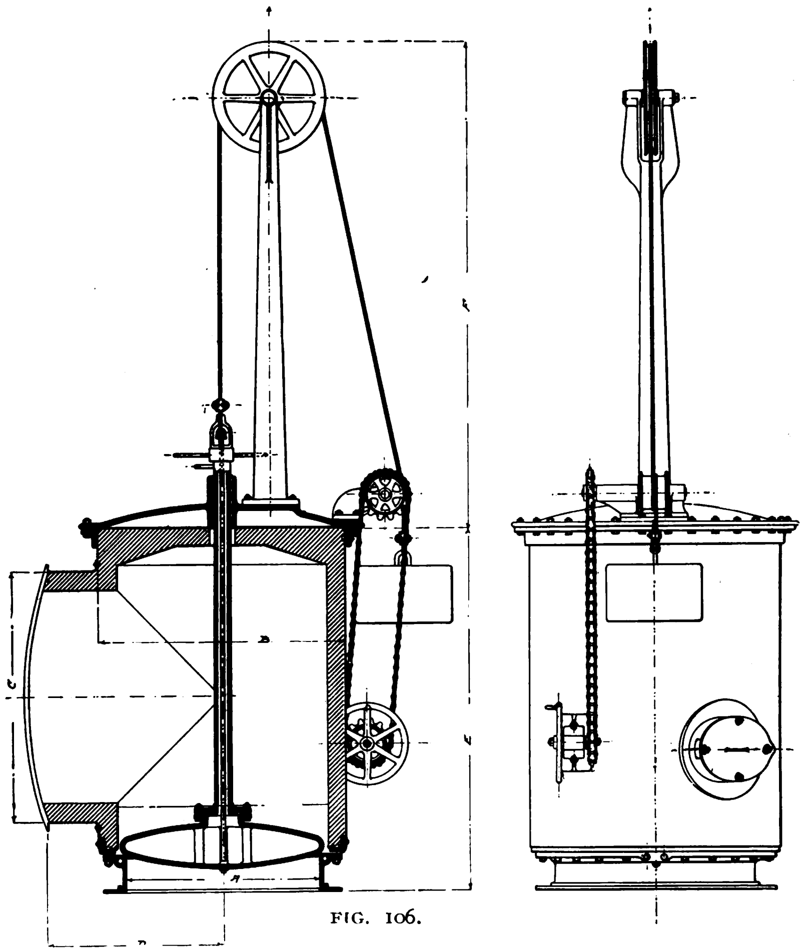


FIG. 106.

	A	B	C	D	E	F	G	PRICE.
Fig. 106.	48″	61½″	61½″	42¾″	7′ 5″	10′ 0″	52″	

Sliding Chimney Valves.

Operated in a Vertical Position.

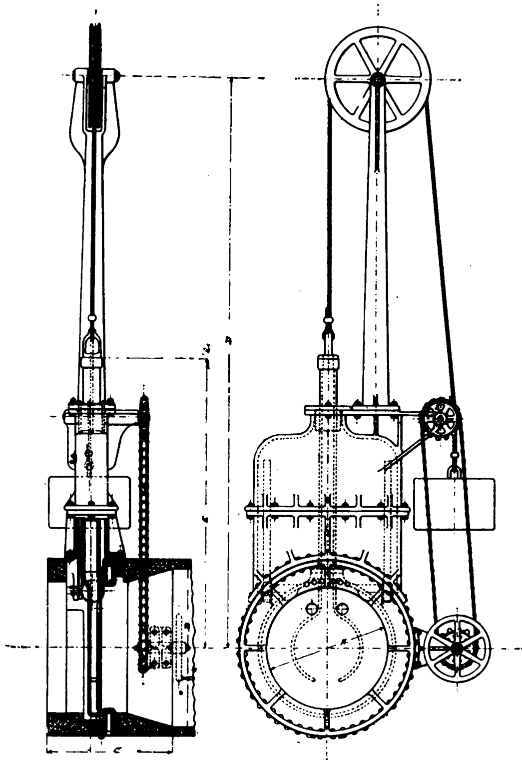


FIG. 107.

A	B	C	D	E	Price.
30″	43″	36″			
36″	52″	36″	14′	7′ 0″	
42″	58″	36″			
46″	62″	36″			

The above valves are constructed similarly to those described on page 96, but are operated in a vertical direction.

Sliding Chimney Valves.

Operated in a Horizontal Position.

The valve casings are made of plate iron. The valve seats are hollow castings riveted to the inside of the casings. The saddles are made heavy, and are riveted to the outside of the casings. The caps are bolted to the saddles, and are provided with valve stem guides. The valves are hollow disc castings, to which hollow stems are bolted. Racks are cut in these stems, in which pinions work. A rope sheave is fitted to the pinion shaft.

The construction of the valve and seat is such that the draft of the chimney induces a strong current of cool air, thereby protecting them from the heated gases.

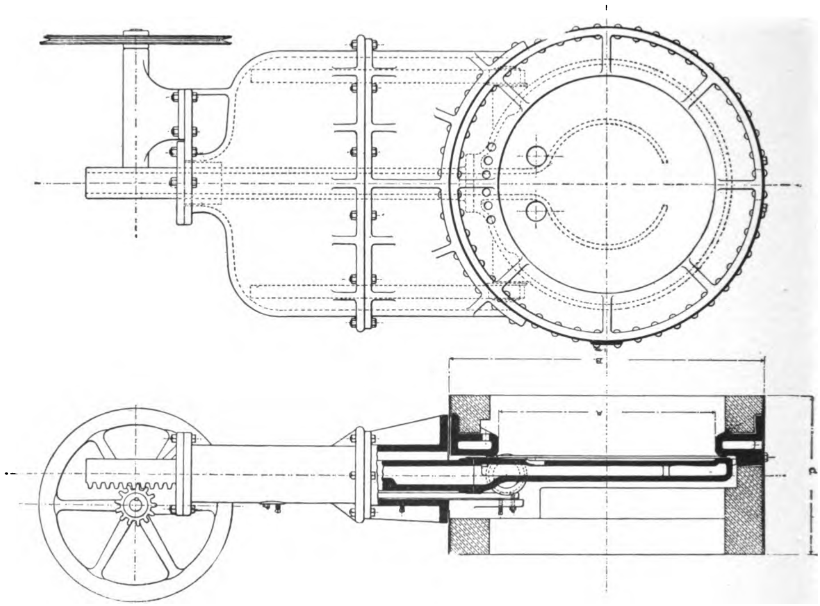


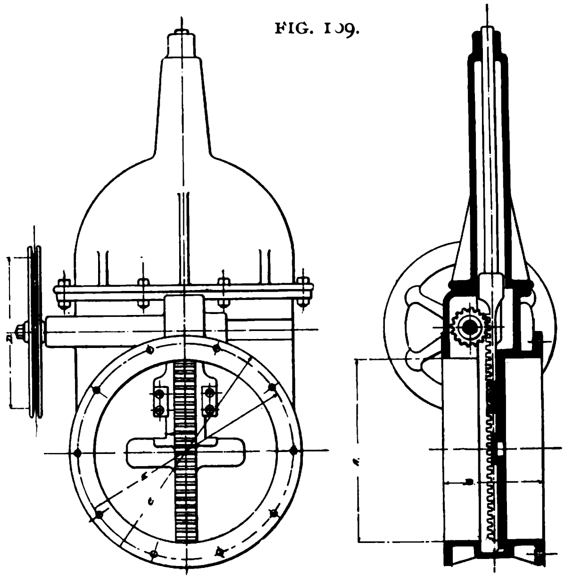
FIG. 108.—CHIMNEY VALVE.

A	B	C	Thick Plate.	Length Over All.	PRICE.
30″	43″	24″	$\frac{5}{16}$″		
36″	52″	24″	$\frac{5}{16}$″		
42″	58″	24″	$\frac{5}{16}$″		
46″	62″	24″	$\frac{5}{16}$″		

Cold Blast Valves.

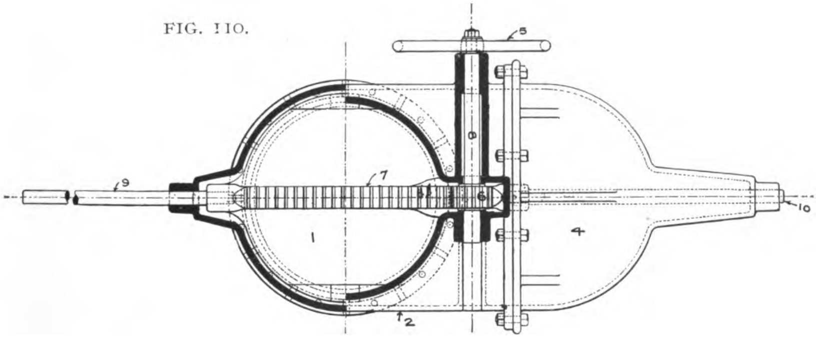
These valves are of the gate type, and are made for pressure on one or both sides. Those illustrated: *Fig. 109* are made for pressure on one side only; *Fig. 110* are made for pressure on both sides, and can be operated side or endwise. The main valve is machined to fit the seat. A small auxiliary valve is fitted upon the top of the main valve, the whole being operated by means of a rack and pinion. The valve may be constructed without the auxiliary valve, if desired. A rope sheave or hand wheel will be supplied.

FIG. 109.



A	B	C	D	E	Thickn's Body.	Thickn's Flange.	PRICE.
10″	8″	15½″	10″	13½″	7/16″	⅝″	
17″	13″	22¼″	20″	20¼″	½″	13/16″	
20″	13″	25¾″	20″	23¾″	½″	⅞″	
22″	13″	27½″	20″	25½″	½″	13/16″	
22″	13⅜″	27⅞″	20″	25⅞″	¾″	1⅛″	
24″	13″	29¼″	20″	27¼″	⅝″	1″	
24″	13″	29¼″	20″	27¼″	¾″	1″	
26″	13″	31¼″	30″	29¼″	⅝″	1″	

FIG. 110.



These valves are made in all sizes given in above list.

Spearman Kennedy Gas Burners.

For Fire Brick Hot Blast Stoves.

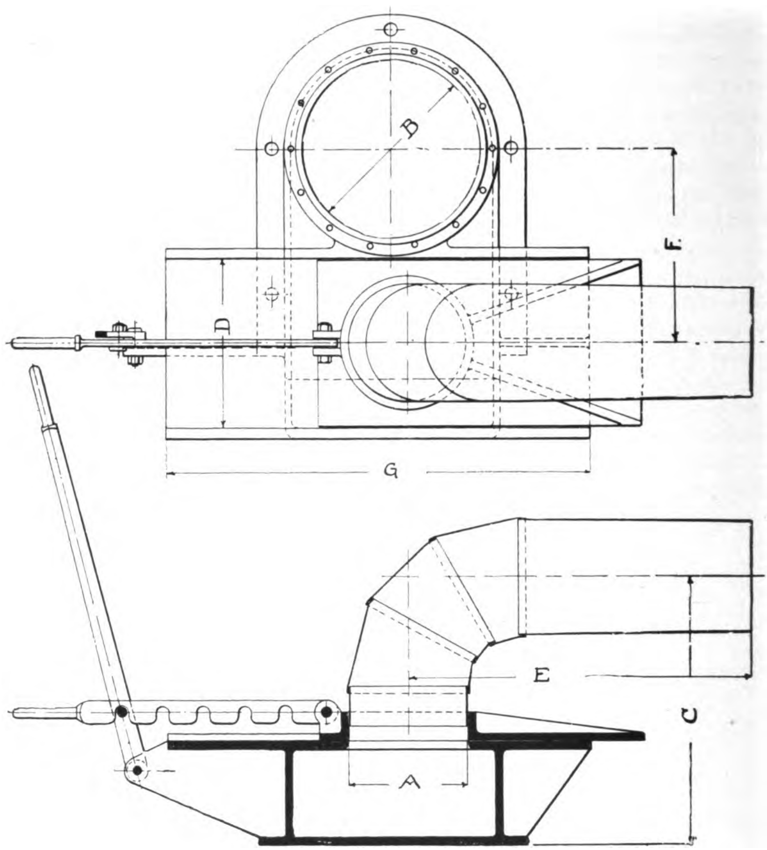


FIG. III.

The bodies are made of cast iron, provided with a connection and flange for overhead gas mains.

The elbow is made of steel plate and is riveted to the valve proper. The valve is operated by means of a linked lever as shown.

A	B	C	D	E	F	G	Price.
16″	24″	36″	22½″	3′ 10″	26″	4′ 8¾″	

Gas Inlet Valves.

SPEARMAN KENNEDY PATENT VALVES.

The bodies are heavy castings, machined upon the top surfaces. The valve is a sliding plate of iron, machined on the lower surface. Upon one end of this plate is cast a port opening, to which is attached a wrought iron pipe elbow. When the valve is open the port is concentric to port openings in the bodies; when closed, the solid part of plates cover the port openings in body. It is actuated by means of a rack and pinion. This type of valve requires in addition to the above an air valve, frames and door described in *Figs. 116* and *126*, pages 102 and 107.

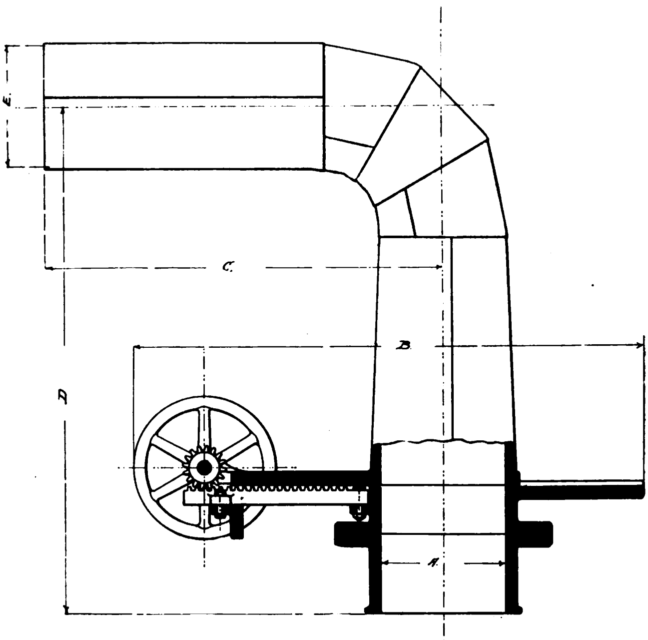


FIG. 112.

A	B	C	D	E	PRICE.
12″	39″	27″	34″	8″	
14″	58″	45″	57″	14″	
18″	70″	50″	57″	18″	

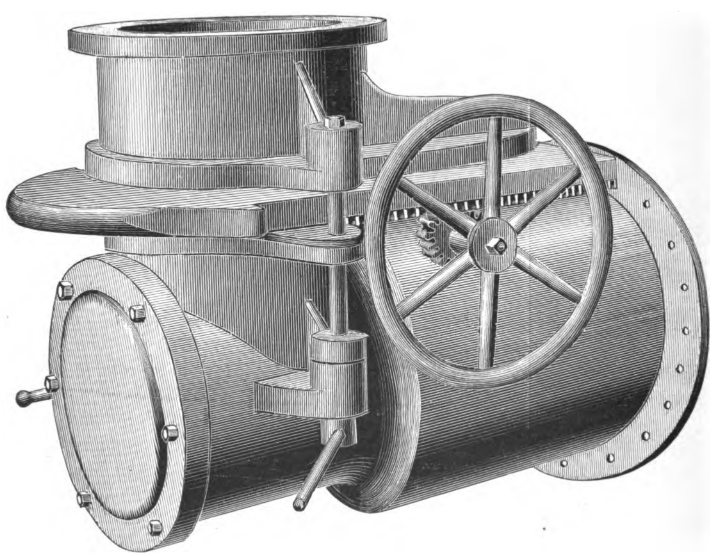
Gas Inlet Valves.

For Fire Brick Hot Blast Stoves.

The valves are made of cast iron, planed on both sides and operated back and forth by means of a rack and pinion, in a horizontal direction, between two flanged parts of the body. In one end of the valve there is a port. When it is fully open this port is concentric or in alignment with the ports of the same diameter in the bodies. When closed, the solid part of the valve is between the ports in the bodies. It can, however, be opened partially or entirely, as may be desired, thereby acting at the same time as a regulating valve. It is made tight between the bodies by means of two vise clamps. They are always in view and can be kept clean, and if through carelessness they should leak, the hot blast cannot enter the gas flues, but will pass directly into the atmosphere.

In ordering, state whether overhead or underground connections are wanted.

FIG. 113.



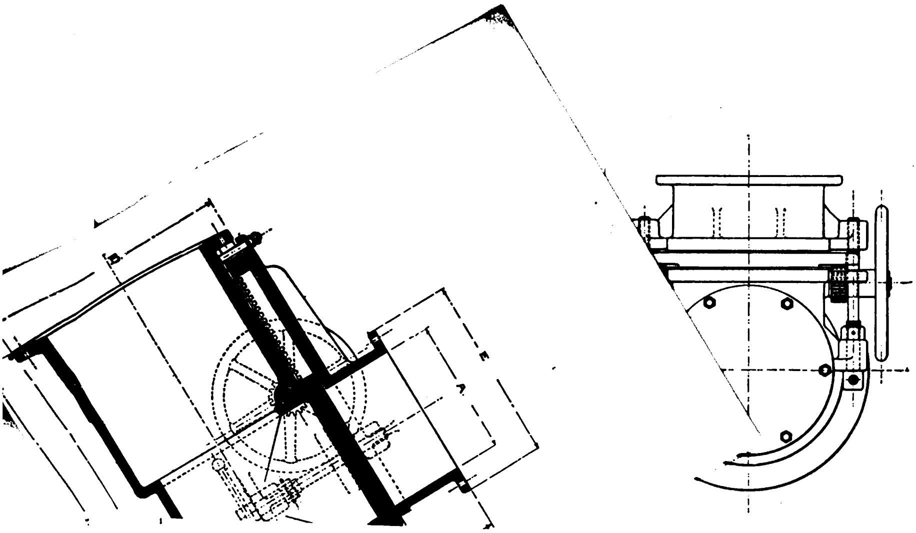


FIG. 114.—GAS VALVE FOR OVERHEAD GAS MAIN.

	A	B	C	D	E	F	PRICE.
Fig. 115.	16″	28″	61½″	2½″	30″	47″	
"	18″	31″	64″	2½″	32″	51″	

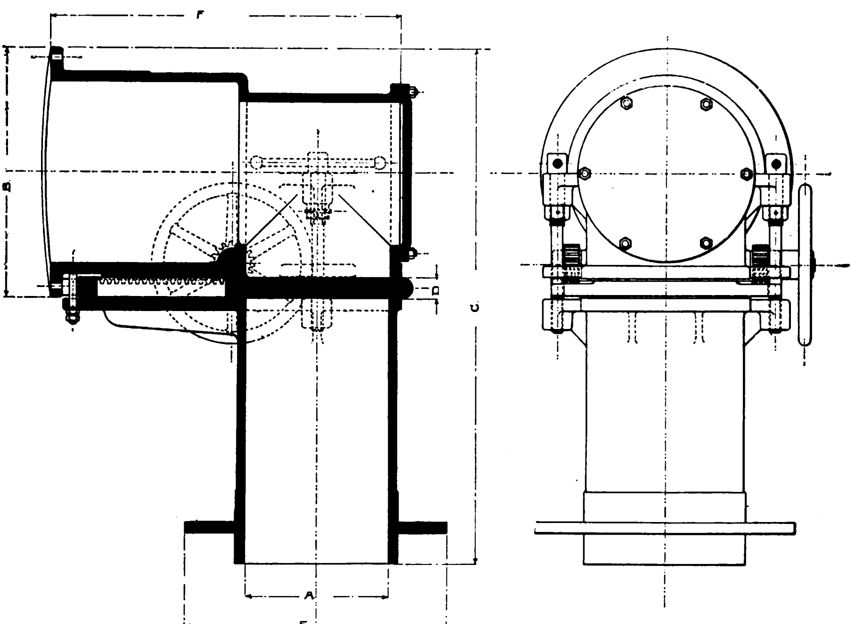


FIG 115.—GAS VALVE FOR UNDERGROUND GAS FLUES.

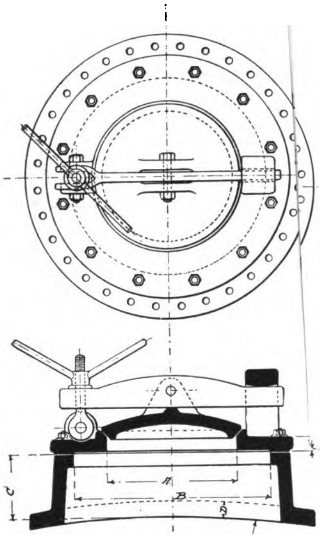


FIG. 116.

Air Valves.

For Spearman Kennedy Gas Valves.

The frames are made of cast iron, provided with heavy flanges. A valve seat is bolted to a machined surface on the frame. The valve is spherical in shape and is fitted to the seat with a bevelled surface. It is held firmly to a seat by a cast iron bar, secured to the frame on one end by a fixed leg and to the other by a link bolt, provided with a double wrench. The valve is also provided with [illegible], rod and track, by means of which it is removed to one side of the frame when the gas valve is to be inserted.

A	B	C	D	E	F	Price.
16″	24″	8″	1½″	1¾″	Any radius	
20″	24″	8″	1½″	1¾″	"	

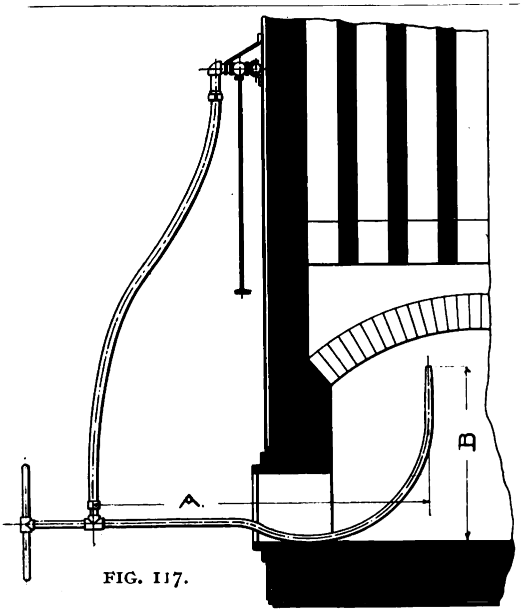


FIG. 117.

Steam Cleaning Sweepers.

Patented.

To rapidly remove and clean the bottoms of fire brick stoves this device will be found convenient. It consists of a piece of gas-pipe, bent upon one end, and attached to a steam supply pipe by means of a rubber hose at the other end. A cut-off valve is supplied with each sweeper. We make them for all sizes of stoves, from 14 feet diameter and upwards.

Cleaning Crane.

For Fire Brick Hot Blast Stoves.

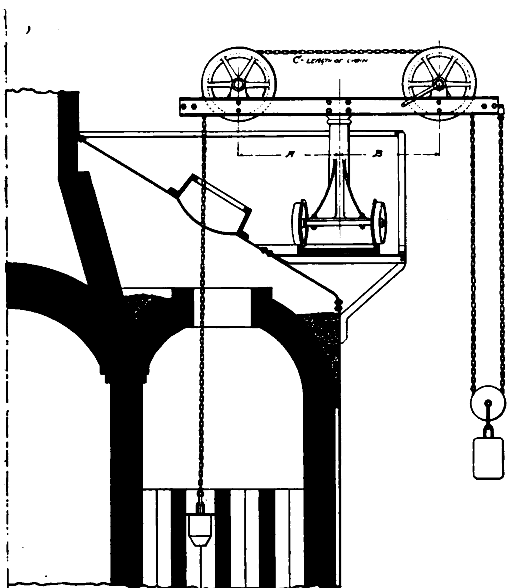


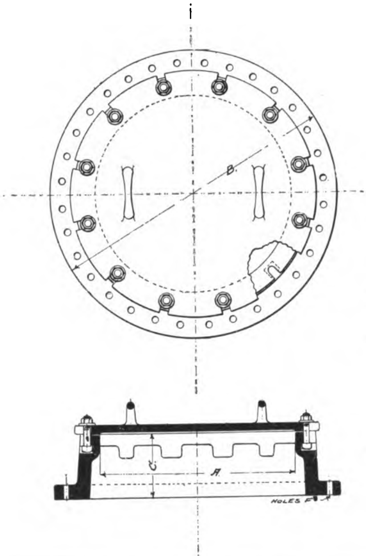
FIG. 118.

These cranes are designed to travel upon tracks fastened to the top of fire brick stoves. The jibs are made of channel iron, sufficiently long to reach door openings at any point on the tops, and are fastened to cast iron pivots. The sockets for these pivots form the truck frames, which are mounted on four cast iron wheels.

Two chain sheaves, working in bearings, are placed upon the ends of the jibs, one of these being provided with a hand crank. A $\frac{5}{16}''$ wrought iron chain works over these two sheaves. A scraping weight and plate is attached to one end of the chain and a counter weight of sufficient weight upon the other end.

The scraping weight is made heavier than the counter weight, and when introduced in a flue to be cleaned will rapidly descend, the plate scraping the walls. It is then hoisted by means of the crank and sheave, and introduced into another flue, etc.

Diam. Stoves.	A	B	C	Diam. Wheels.	Jib, 5″ Channels.	Price.
14″, 15″, 16″	46″	46″	78″	12″	2′ 5″	
17″, 18″	56″	56″	80″	12″	2′ 5″	
19″, 20″	62″	62″	82″	12″	2′ 5″	



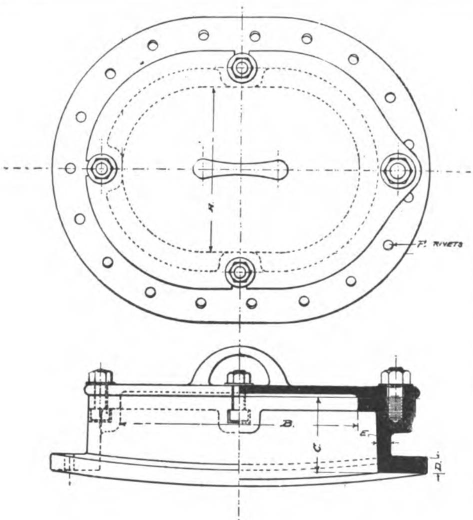
Circular Cleaning Doors.

For Stove Tops, Etc.

The frames are made circular in form, and are provided with heavy flanges. The doors are machined and bolted to the frames. The flanges are made for flat or curved surfaces.

FIG. 119.

A	B	C	Thick Flange.	Thick Body.	F	Price.
16″	25½″	5″	1¼″	⅞″	$\frac{11}{16}$″	
24″	35″	8″	1¾″	1½″	$\frac{11}{16}$″	



Oblong Cleaning Doors.

For Stove Tops, Etc.

The frames are made of cast iron, the flanges being made for flat or curved surfaces and heavy. The door is fitted to the frame with machined surfaces, and is made to hinge on one bolt.

FIG. 120.

A	B	C	D	E	F	Price.
11″	16″	5″	1⅛″	⅞″	$\frac{11}{16}$″ 3½ cntrs.	

Square Cleaning Doors.

For Stove Bottoms.

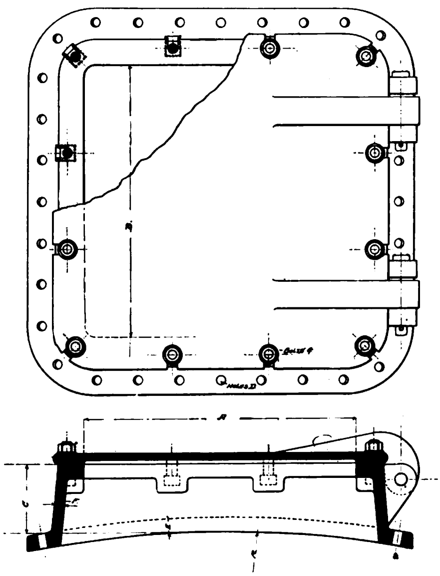


FIG. 121.

The frames are made of cast iron, provided with heavy flanges. They are machined on the upper surface, to which is fitted a machined door. These doors are hinged to the frames, and can be thrown out of the way when desiring to clean through them. The doors are securely bolted with T-head bolts to the frames, making them air tight, for 15 pounds pressure to the square inch. We make them to fit flat or curved surfaces.

A	B	C	D	E	F	G	Price.
21″	27″	5″	32-$\frac{11}{16}$″	1⅛″	¾″	12¾″	
24″	24″	6″	32-$\frac{11}{16}$″	1¼″	⅞″	12¾″	
24″	24″	4″	32-$\frac{11}{16}$″	1⅛″	¾″	12¾″	
30″	30″	7″	38-$\frac{11}{16}$″	1¼″	1″	12¾″	
36″	36″	8″	50-$\frac{11}{16}$″	1½″	1″	12¾″	

Manholes.

The frames are made of cast iron and provided with either curved or flat flanges. The doors are fitted to the frame with machined surfaces. Styles *Fig. 122* or *Fig. 123* furnished to sizes given in lists.

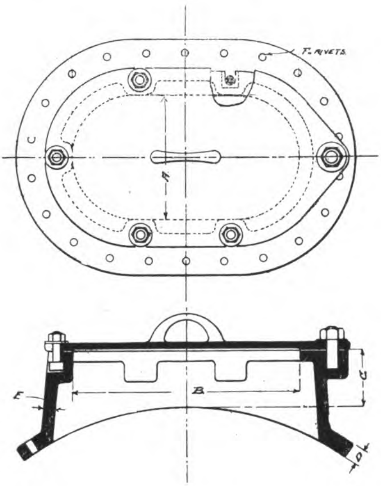


FIG. 122.

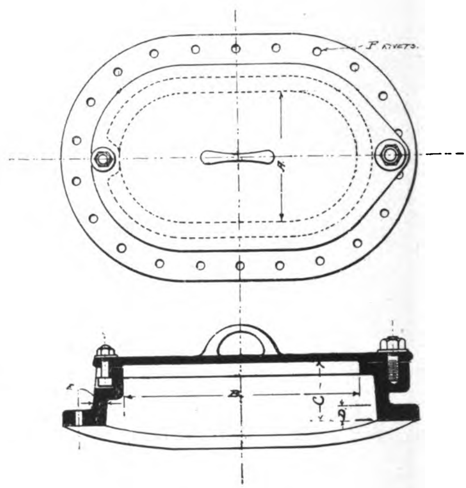


FIG. 123.

A	B	C	D	E	F	PRICE.
11″	16″	5″	⅛″	⅞″	$\frac{11}{16}$″	
11″	20″	5″	⅛″	⅞″	$\frac{11}{16}$″	

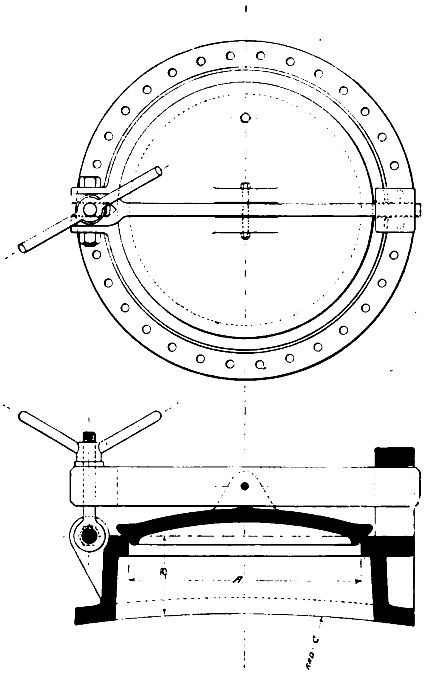


FIG. 124.

Circular Cleaning Doors.

FOR STOVE BOTTOMS.

The frames are made of cast-iron, provided with heavy flanges. The door or valve is spherical in shape, and is fitted to the frame with a bevelled seat. It is held firmly to the frame seat by a cast iron bar, secured on one end to fixed legs on the frame, and on the other end by eye bolts provided with double wrench nuts.

We can also furnish with the door a trolley, rod and tracks, as shown in *Fig. 126*, by means of which the door can be moved to one side of the frame, when it is desired to clean the stoves. In ordering, state whether trolley or track are wanted or not.

	A	B	C	Thick Body.	Thick Flanges.	Thick Lid.	PRICE.
Fig. 124.	16″	5″	Any	7/8″	1 1/4″	1″	
" *124.*	24″	8″	"	1 1/2″	1 3/4″	1″	

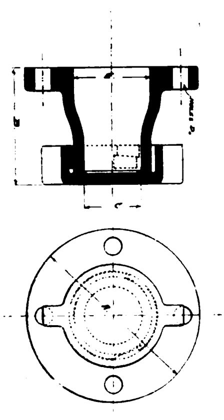


FIG. 125.

Eye Sights, or Poke Holes.

Are made of cast iron. A piece of glass or mica is clamped by means of the cap to the body.

A	B	C	D	E	PRICE.
6 3/4″	4 1/2″	2″	4-11/16″	3″	

Air Valves.

For Hot Blast Stoves.

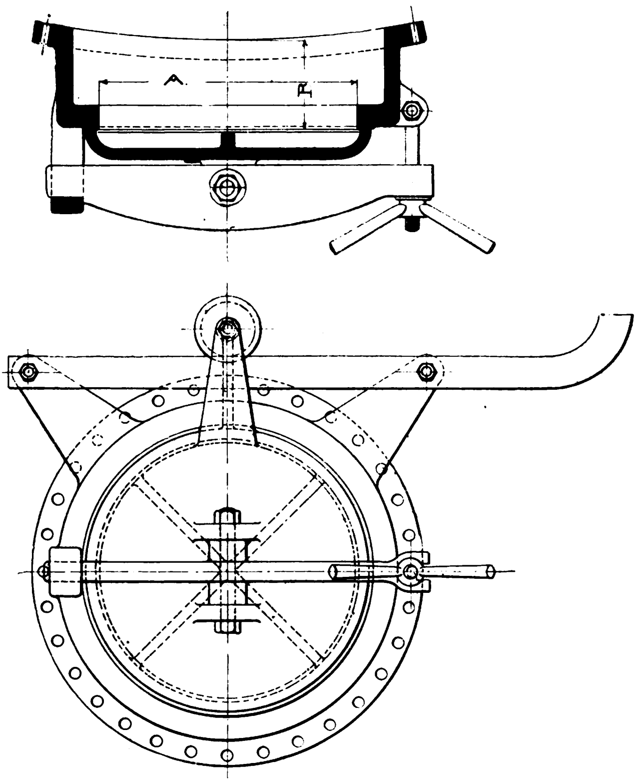


FIG. 126.

The frames are heavy castings, flanges cored for rivet holes. The valve s a ribbed casting and supported by a small roller arranged to traverse a track fastened to frame. The seat is flat and carefully machined. The valve is held in place by means of a cast-iron yoke.

	A	B	PRICE.
Fig. 126	24″	8″	

Cleaning Doors and Air Ports.

FOR HOT BLAST STOVES.

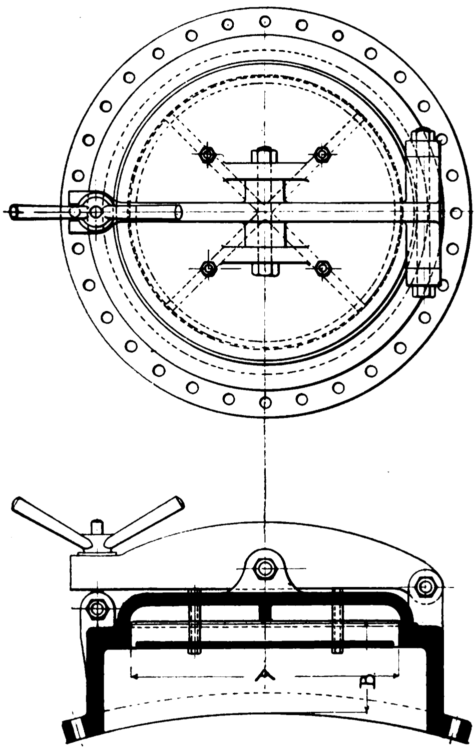


FIG. 127.

The frames are heavy castings, flanges cored for rivet holes. The door is fitted with a liner plate and swung upon a strong cotter bar hinged to the frame. The seat is flat and carefully machined.

	A	B	PRICE.
Fig. 127	24″	8″	

Air Valves.

The valve seat is bolted to the head of the hot blast valve branch. The valves are made of cast iron and provided with lining plates. They are swung upon wrought iron hinge bars. A hand wheel, screw and bail is fastened to the seat, by means of which the valve can be screwed up tight and fast.

These valves and seats can also be fitted to circular or square cleaning doors, as shown in *Fig. 129*.

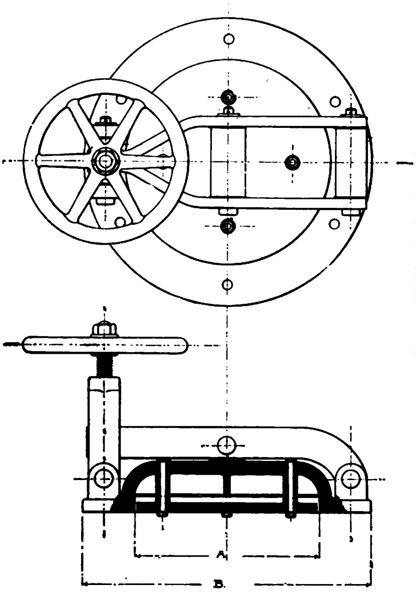


FIG. 128.—AIR VALVE.

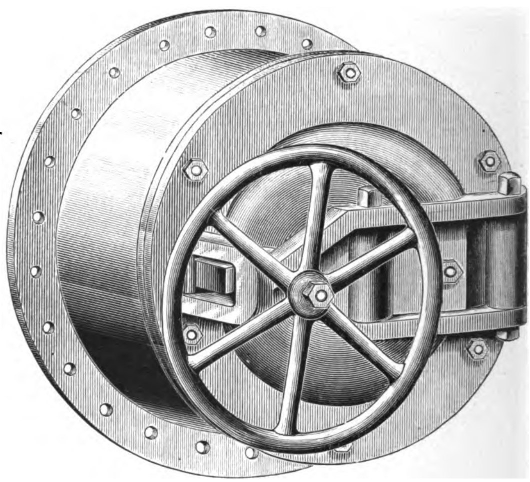


FIG. 129.

A	PRICE.
16″	
18″	

Operating Sheaves, Guide Rollers, Ropes, Etc.

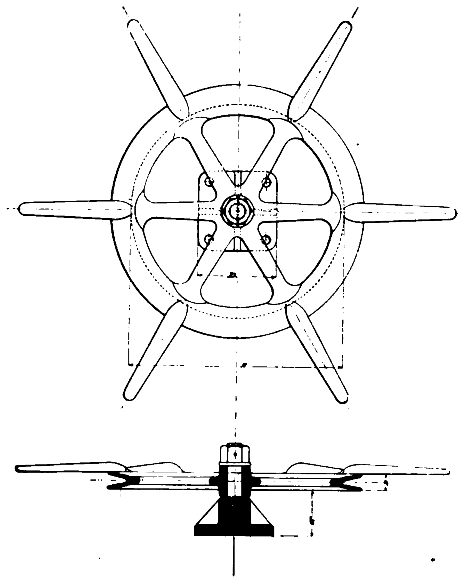


FIG. 130.

For Chimney Top Stove Valves, Etc.

The sheaves, *Fig. 130*, are bored and carefully fitted to a cast-iron bracket, which can be riveted to the stove shells. Each sheave is provided with spokes, by means of which they can be revolved.

The rollers, *Fig. 131*, are carefully fitted in a swivelling fulcrum, and can be adjusted to guide the ropes in any direction.

The ropes are made of wire, provided with clevices, turn-buckles, etc.

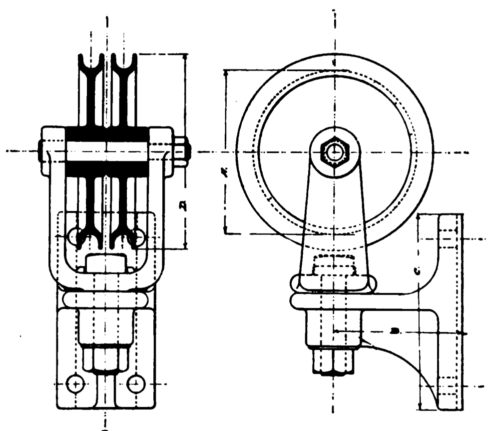


FIG. 131.

	A	B	C	D	Price.
Fig. 130.	18⅞″	3⅜″	2¾″	7″	
" *131.*	6¾″	5¼″	8″	8″	

Gas Burners for Boilers.

PATENTED BY SPEARMAN & KENNEDY.

The body is a heavy casting machined upon the top surface. The valve is a sliding plate of iron machined on the lower surface. Upon one end of this valve is a port opening, to which is attached a rectangular pipe. When the valve is open the port is directly over port in the body. When closed the solid part of the valve is over the port in the body. It is operated by means of a lever and link, as shown in *Fig. 132*.

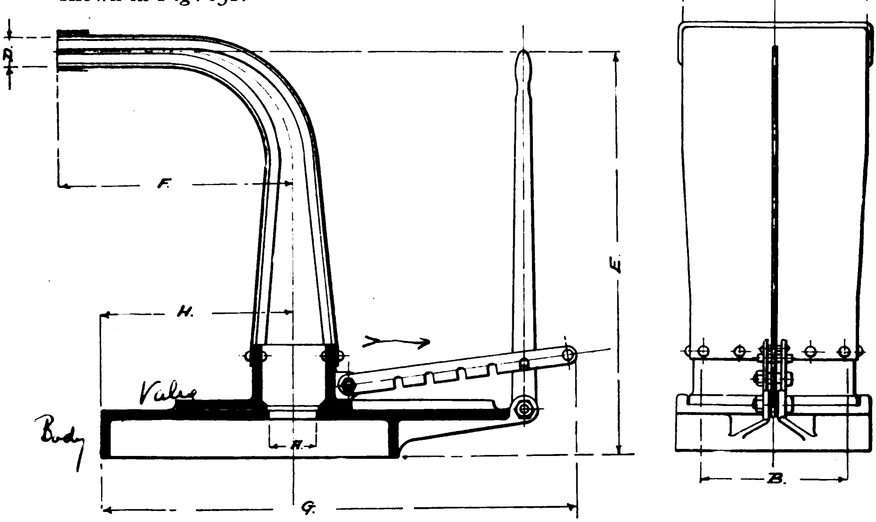


FIG. 132.

A	B	C	D	E	F	G	H	PRICE.
6″	18″	24″	4″	54″	30″	60″	24″	

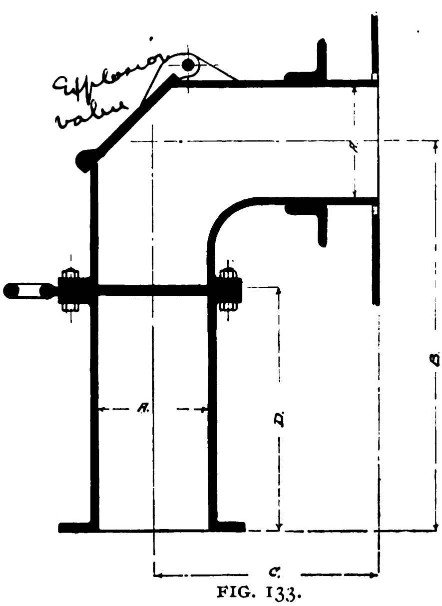


FIG. 133.

Gas Burners.

FOR BOILERS OR HOT BLAST STOVES.

These burners are designed for small boiler plants. The body is circular in form, made of cast iron. A sliding damper is provided by means of which the gas may be entirely cut off or regulated to suit requirements. A cleaning and explosion door is fitted to the elbow of the body. A loose ring is fitted to the nozzle of the burner, by means of which the air supply is regulated.

A	B	C	D	PRICE.
11″	38″	22″	24″	

Gas Burners for Boilers.

PATENTED.

This type of burner is made for either underground or overhead gas mains. The air is admitted through sliding dampers on the sides of the burner, and passes through ports to the combustion chamber. A gas port separates each air port. By this arrangement the air and gas are delivered one on top of the other, in thin, wide sheets, insuring a thorough mixture. A damper is fitted to the gas flue connection, and by means of this and the sliding dampers or air ports, the mixture can be regulated. A large door, hinged to the front end of the body, is provided, through which the whole may readily be cleansed.

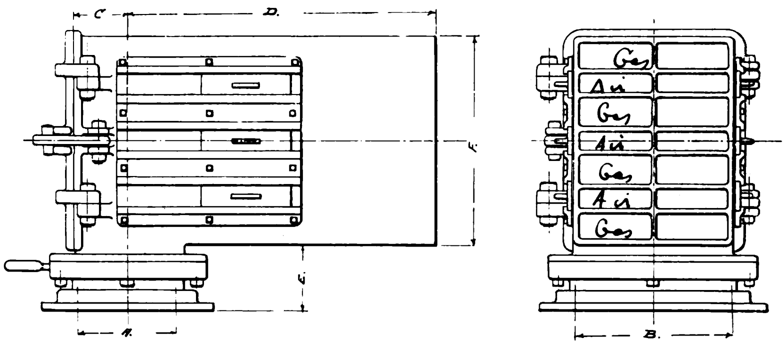


FIG. 134.

	A	B	C	D	E	F	PRICE.
Fig. 134 & 135	10″	16″	6″	31″	7″	22¼″	

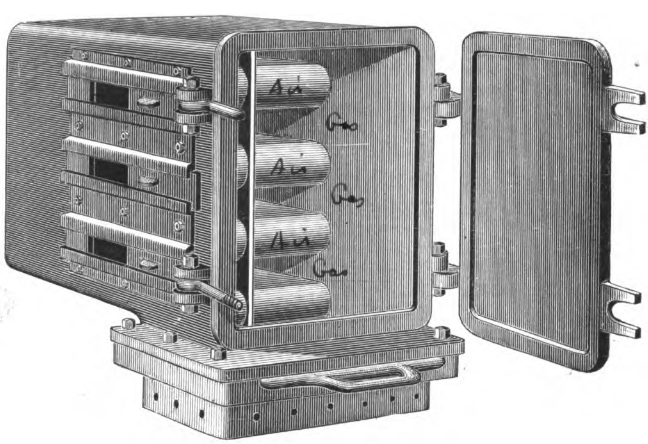


FIG. 135.

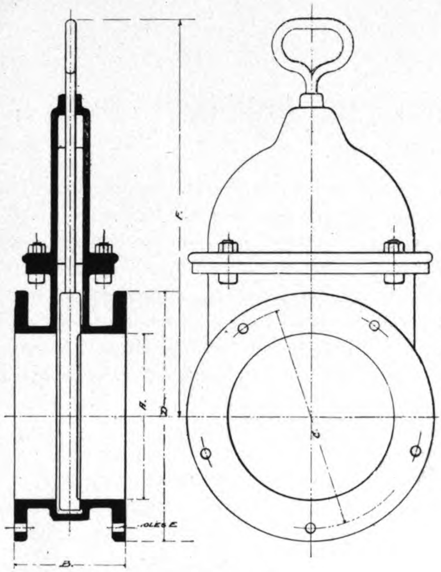


FIG. 136.

Gate Valves.

FOR AIR OR GAS.

The bodies and valves are made of cast iron. They can be made for pressure on either side of the valve.

	A	B	C	D	E	F	Thick Body.	Thick Flange.	PRICE.
Fig. 136.	12″	8″	16″	18″	5-$\frac{11}{16}$″	29″	$\frac{7}{16}$″	⅞″	
" *136.*	15″	11″	19¾″	22″	8-$\frac{15}{16}$″	36″	1″	1½″	
" *137.*	12″	8″	16″	18″	5-$\frac{11}{16}$″		$\frac{7}{16}$″	⅞″	
" *137.*	15″	11″	19¾″	22″	8-$\frac{15}{16}$″		1″	1½″	

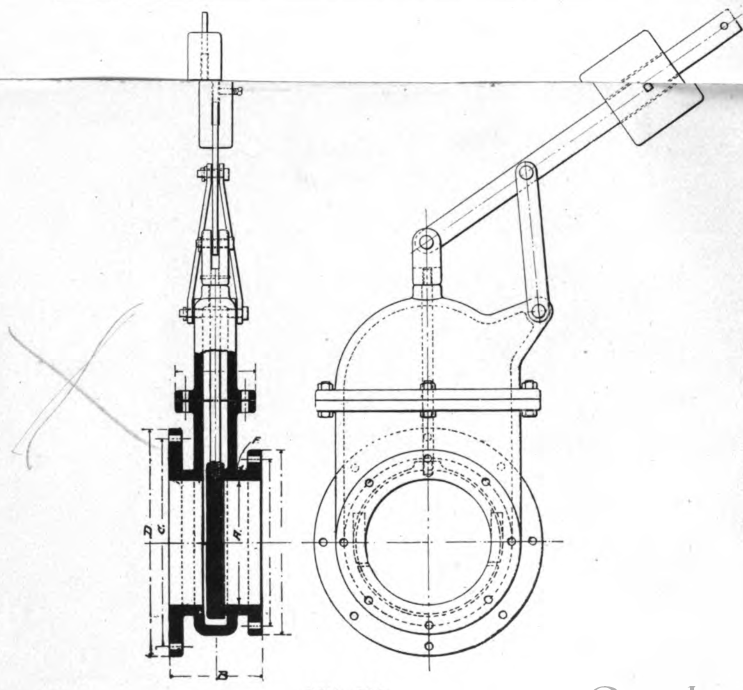


FIG. 137.

Washout Valves and Overflow Pipes.

For Water Tanks and Reservoirs.

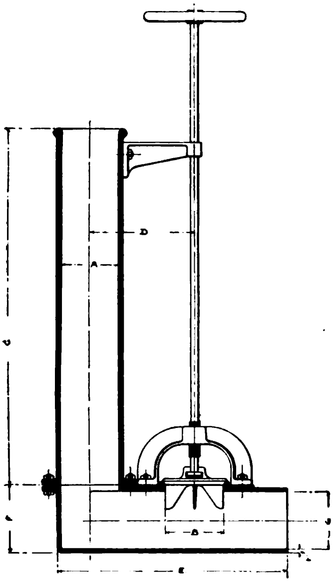


FIG. 138.

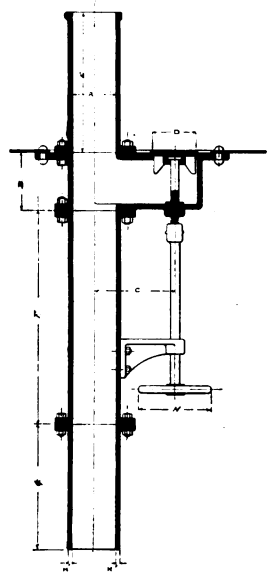
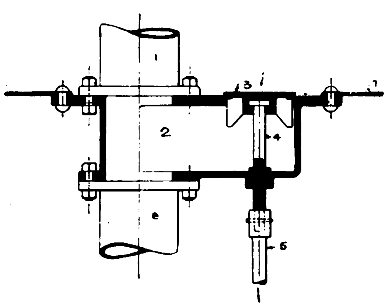


FIG. 139.

	A	B	C	D	E	F	G	H	PRICE.
Fig. 138.	10″	10″	61½″	18″	39″	11⅝″	10″	⅝″	
" *139.*	6″	7¾″	11″	6″	14′ 6″	18″	4⅓″	½″	



DETAIL FIG. 139.

The valve is made of cast iron, and is operated by means of a screw stem provided with a hand-wheel. As the length of the overflow and discharge pipes vary for different heads of water, we can only quote prices upon application, giving height of tank and length of discharge pipes. *Fig. 138* illustrates the hand-wheel above the valve, and *Fig. 139*, below. In ordering, state which is wanted.

Gas Producers.

For Steel Works, Gas Works, Brick Kilns or Other Purposes where Artificial Gas can be Used.

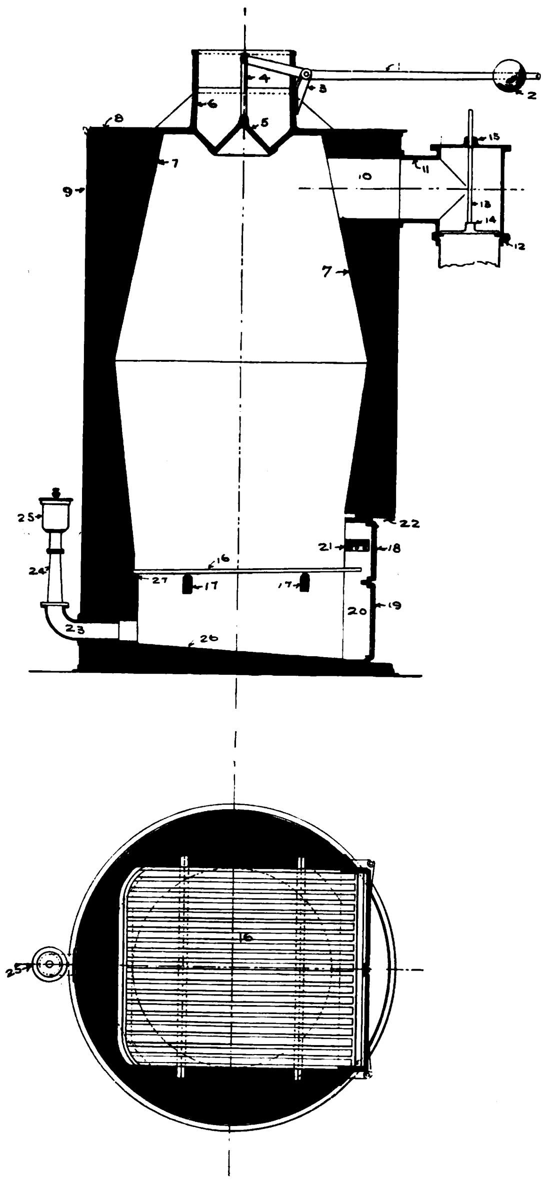


FIG. 140.

The shells (9) are made of wrought-iron and lined with fire-brick (7), as illustrated. The grate bars (16) are made of wrought iron. The ash pit doors (19) are made of cast iron hinged to a heavy frame (20). When drawing ashes, the grate bars (16) are withdrawn one by one and driven into the ash above bearing bars (21). The ashes below bars in this position fall to bottom of chamber (26) and are then withdrawn through door (19). A bell and hopper 5 and 6 is fitted to the top through which the producers are fed The gases pass out through a puppet valve (14). A steam air injector (24 and 25) is fitted to the bottom of casing. These producers will gasify from 4 to 5 tons of coal per day.

Prices upon application.

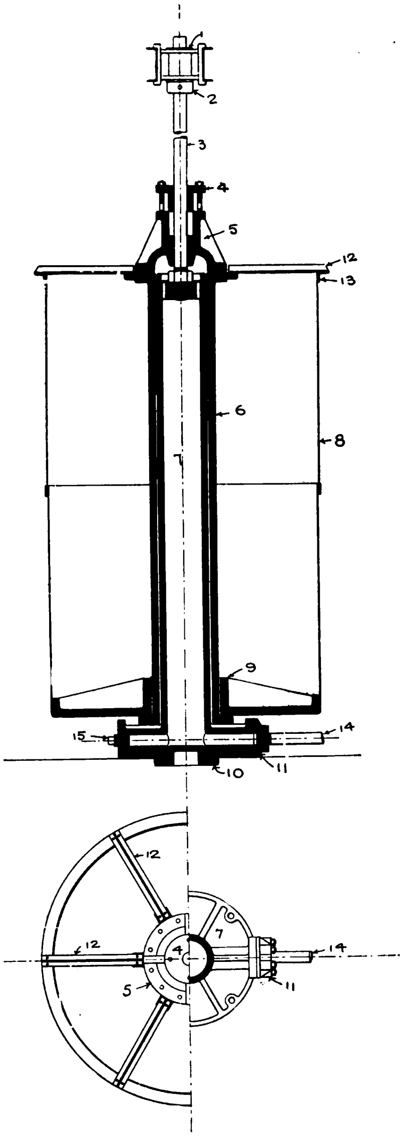


FIG. 141.

14″ x 120″ Accumulators

14″ DIAMETER BY 120″ STROKE.

The ram (7) is stationary, 14″ in diameter, and securely bolted to a foundation. The cylinder (6) is 17½″ outside diameter, made very heavy, and is guided by means of a long stuffing box (5) sliding on a guide rod (3), 3½″ diameter. This rod is held at the bottom by the ram (7), and at the top by the bearing (1), secured to the roof trusses.

The weight box (8) is 71″ in diameter, and rests upon a flange on the cylinder (6). The shell is made of plate iron, $\frac{5}{16}$″ thick, braced at the top by means of **T** bars.

It can be weighted up with borings, etc., for 500 pounds pressure per square inch.

Price f.o.b. ....

Butterfly Valves.

FOR GAS MAINS.

The valves are made of cast iron strongly ribbed. A wrought-iron shaft passes through the valve, and is fitted up with a lever. The shaft, bearing on one side, is riveted to the wrought-iron pipe. A frame is riveted to the wrought-iron pipe, and is made sufficiently large to remove the valve through it. The door forms the other bearing of the shaft.

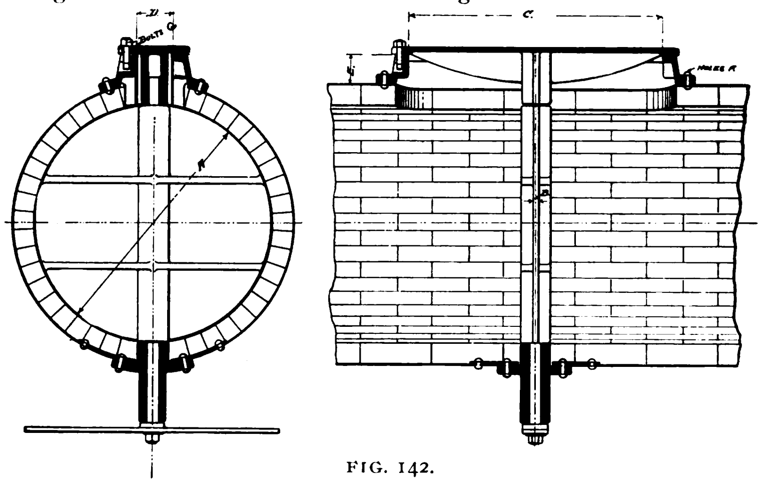


FIG. 142.

	A	B	C	D	E	F	G	PRICE.
Fig. 142	30″	¾″	32″	5″	6¾″	16′ $\frac{11}{16}$″	6′ ¾″	
"	37″	¾″	42″	5½″	4″	16′ $\frac{11}{16}$″	8′ ¾″	
"	34″	¾″	48″	6½″	4″	20′ $\frac{11}{16}$″	8′ ¾″	
"	46″	¾″	51″	6½″	5⅞″	18′ $\frac{11}{16}$″	6′ 1″	
"	49″	¾″	51″	6½″	5⅞″	18′ $\frac{11}{16}$″	6′ 1″	

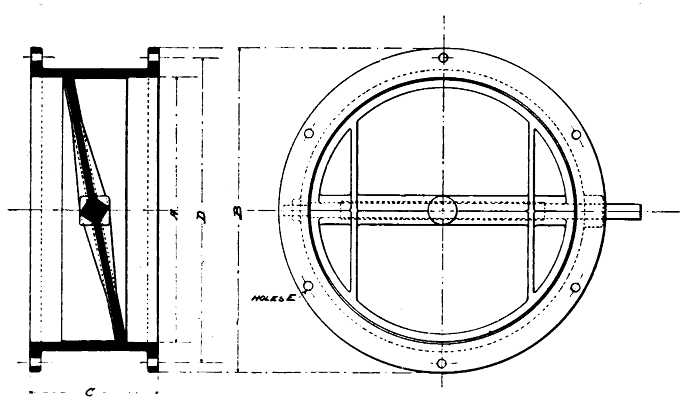


FIG. 143.

	A	B	C	D	E	PRICE.
Fig. 143	25″	30½″	12″	28¾″	6-$\frac{13}{16}$″	

Crushers, or Pulverizers.

FOR ORE, BRICK, CLAY, ETC.

The pan (1) is 5′ 0″ in diameter and 10″ deep, made heavy and of cast-iron. The pivot is 8″ in diameter and works upon steel adjustable sets. The pan is further guided by means of four conical friction rollers (14) placed immediately below the crushing rollers (2). A bevel gear (6 and 7) and pinion gives motion to the pan, through the shaft (12) and pulleys (10), one of the latter being tight and the other loose. The standards (3) are made of cast iron and bolted to the bed plate (8). The roller tires (2) (2) are made of white iron, and are driven with wooden wedges, upon hubs secured to the stationary shaft (4). Each of these rollers weighs 3,560 lbs., and is 40″ in diameter. They roll upon chilled segmental plates, set in the bottom of the pan (1). A scraper is provided for each roller. The whole machine is very heavy.

Price, f.o.b. ....

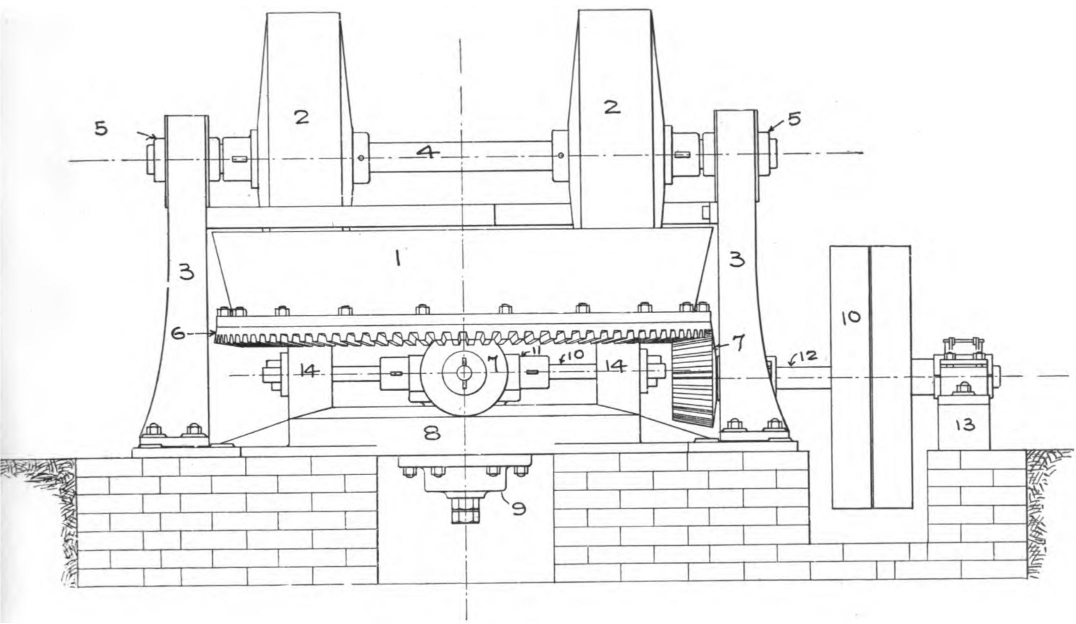
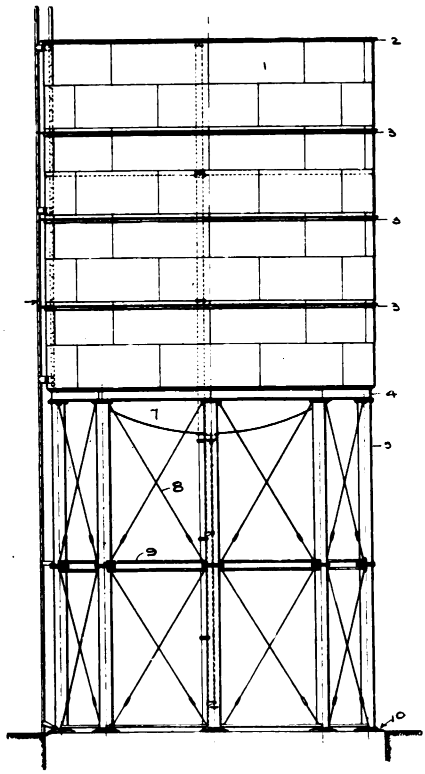


FIG. 144.

Wrought-Iron Tanks.

For Water, Brine, Etc.



These tanks are built for storage or pressure purposes of any capacity. They are supported on wrought-iron trussed columns or wooden braced structures. The bottoms are made spherical in shape, of good tank steel. The sides are made of steel or iron plates. All vertical seams double riveted and the whole carefully caulked.

When ordering, state capacity and pressure needed.

Prices on application.

Table No. 1.

Atomic Weights and Specific Gravity of Elements Met in Blast Furnace Practice.

Name.	Symbol.	Atomic Weight.	Specific Gravity, Water = 1.	Specific Gravity, Air = 1.
Alumnium, ...	Al	27.5	2.6	
Calcium, ...	Ca	40.	1.58	
Carbon, ...	C	12.		
Chlorine, ...	Cl	35.5	Liquid 1.33	
Chromium, ...	Cr	52.5	7.01	
Cobalt, ...	Co	59.0	8.49	
Copper, ...	Cu	63.5	8.95	
Flourine, ...	F	19.0		
Gold, ...	Au	196.0	19.34	
Hydrogen, ...	H	1.0		0.0694
Iron, ...	Fe	56.0	7.84	
Lead, ...	Pb	207.0	11.39	
Magnesium, ...	Mg	24.0	1.74	
Manganese, ...	Mn	55.0	8.03	
Mercury, ...	Hg	200.0	Liquid 13.6	
Nickel, ...	Ni	58.0	8.6	
Nitrogen, ...	N	14.0		0.969
Oxygen, ...	O	16.0		1.108
Phosphorus, ...	P	31.0	1.9	
Platinum, ...	Pt	197.5	21.5	
Potassium, ...	K	39.	0.86	
Silicon, ...	Si	28.	1.08	
Silver, ...	Ag	108.	10.4	
Sodium, ...	Na	23.	0.97	
Sulphur, ...	S	32.	2.00	Vapor 2.216
Tin, ...	Sn	118.	7.3	
Titanium, ...	Ti	50.		
Tungsten, ...	W	184.	17.3	
Zinc, ...	Zn	65.	7.13	

Table No. 2.

Specific Heats and Gravity of Gases.

Name.	Specific Heats. Equal Weights.	Specific Heats. Equal Vols.	Specific Gravity.
Air,	.2374	.2374	1.
Oxygen,	.2175	.2405	1.1056
Nitrogen,	.2438	.2368	.971
Hydrogen,	3.4090	.2359	.0693
Carbonic Oxides,	.2450	.2370	.968
Carbonic Acid,	.2164	.3308	1.524
Marsh Gas,	.5929	.3277	.5577
Olefiant Gas,	.4040	.3907	.9784 or 9.672
Water Vapor,	.4805	.2989	.6219
Chlorine,	.1210	.2965	2.45
Blast Furnace Gases,	.237		

Table No. 3.

Specific Heats of Solids.

Name.	Specific Heat.
MgO,	.244
CuO,	.142
NO,	.159
Iron,	.1138
Nickel,	.107
Manganese,	.1217
Phosphorus,	.188
Silver,	.057
Tin,	.056
Lead,	.03
Carbon (Charcoal),	.241
Silica,	.191
Alumina,	.217
Specular Iron Ores,	.167
Fe_2O_3	.203

Blast Furnace Slag, according to its temperature and composition, from 400 to 600 calories.

Pig Iron, 330 calories for No. 3 quality; 360 calories for foundry grades.

Table No. 4.

CALORIC EVOLVED BY THE COMBUSTION OF ONE UNIT OF THE FOLLOWING SUBSTANCES.

Unit of Weight.	Resulting Substances.	By Symbols.	Total Heat.	Relative Weight of Original to Resultant	Theoretical Temperature C.
Hydrogen	Water	H to H_2O	34000	1 to 9	
Carbon	Carbonic Oxide	C to CO	2400	3 " 7	
"	" Acid	C to CO_2	8000	3 " 11	
Carbonic Oxide	" "	C to CO_2	2400	7 " 11	
Carbon, as	Carbonic Oxide to Carbonic Acid	C as CO to CO_2	5600	3 as 7 " 11	
Iron	Protoxide of Iron	Fe to FeO	1350	7 " 9	
"	Magnetic Oxide of Iron	Fe to Fe_3O_4	1582	21 " 29	
"	Peroxide of Iron	Fe to Fe_2O_3	1860	7 " 10	
Phosphorus	Phosphoric Acid	P to P_2O_5	5747	31 " 71	
Silicon	Silica	Si to SiO_2	7830	5 " 15	
Sulphur	Sulphuric Acid	S to SO_3	2500	2 " 5	
Marsh Gas	Carb. Acid and Water	CH_4 to CO_2 and H_2O	13100	1 " 5	
Olefiant Gas	" "	C_2H_4 to CO_2 and H_2O	11900	7 " 31	
Hydrocarbon Gas	" "	$C_{11}H_{22}$ to CO_2 and H_2O	11300	7 " 31	
Zinc		Zn to ZnO	1330	16 " 81	
Tin		Sn to SnO_2	1147	16 " 75	
Copper		Cu to CuO	603	1 " 5	

Table No. 5.

Weight and Composition of Atmosphere.

	Oxygen by weight.	Nitrogen by weight.
Composition,	23 per cent.	77 per cent.
	By Volume.	By Volume.
Composition,	20.8 per cent.	79.2 per cent.
Specific Heat, ... Equal Weights, ...		.2374
Pounds per cubic foot at 60° Far.		.0765
Pounds of oxygen in a cubic foot, ...		.0176
Number of cubic feet of air in one pound, ...		13.07
Cubic feet of air to burn 1 pound of Carbon to CO		76.
" " " 1 " " CO_2		152.
Pounds " " 1 " " CO		5.8
Pounds " " 1 " " CO_2		11.6
Pounds " " 1 " " Coke, (85 per cent. Carbon,) allowing 10% for Carbon impregnation and that burned by the ores, (Good Furnace Conditions,)		4.44
Cubic feet of air to burn 1 pound of Coke, (Good Furnace Conditions)		58.
Cubic feet of air by blowing piston displacement (in ordinary condition of furnace and engine) to burn 1 pound of Coke or Anthracite, ...		72.

Table No. 6.

Compounds Met in Blast Furnace Practice.

Compound of	Name.	Symbol.	Specific Heat.	Specific Weight Water = 1	Specific Weight Air = 1.	Per Cent. by Weight.			
Aluminum	Alumina	Al_2O_3		3.9		Al	53.4	CO	46.6
Calcium	Lime	CaO		2.0		Ca	71.4	O	28.6
"	Carbonate of Lime	$CaOCO_2$		2.5		CaO	56.0	CO_2	44.0
"	Calcium Sulphide	CaS				Ca	55.5	S	44.4
"	Flour Spar	CaF_2		3.15		Ca	51.3	F	48.7
Carbon	Carbonic Oxide	CO			0.969	C	42.8	O	57.2
"	Carbonic Acid	CO_2			1.524	C	27.27	O	72.72
"	Cyanogen	CN				C	46.15	N	53.85
Chromium	Protoxide of Chromium	CrO				Cr	76.7	O	23.3
	Sesquioxide of Chromium	Cr_2O_3				Cr	68.7	O	31.3
Hydrogen	Water	H_2O		1.0		H	11.11	O	88.88
Iron	Protoxide Iron	FeO				Fe	77.77	O	22.22
	Ferric Oxide	Fe_2O_3				Fe	70.00	O	30.00
	Magnetic Oxide	Fe_3O_4				Fe	72.40	O	27.60
Magnesium	Magnesia	MgO		3.1		Mg	60 00	O	40 00
	Carbonate Magnesia	$MgOCO_2$				MgO	47.6	CO_2	52 4
Manganese	Protoxide Manganese	MnO				Mn	77 4	O	22.6
	Red Oxide Manganese	M_3O_4				Mn	72 0	O	28.0
	Sesquioxide Manganese	Mn_2O_3				Mn	70.0	O	30 0
	Peroxide Manganese	MnO_2				Mn	63.2	O	36.8
Phosphorus	Phosphoric Acid	P_2O_5				P	43 6	O	56.4
Potassium	Potash	K_2O				K	83.	O	17.
Silicon	Silica	SiO_2				Si	46 6	O	53.3
Sodium	Soda	Na_2O				Na	74 2	O	25 8
Sulphur	Sulphuric Acid	SO_2				S	50.	O	50 0
	Sulphuric Acid	SO_3				S	40.	O	60 0

Rules Applicable to Blast Furnace Management where the Fuel used is Coke or Anthracite, and when the Blast is Heated to 1,300° to 1,400° F.

(See F. W. Gordon's Paper, Baltimore Meeting, American Institute Mining Engineers, 1892.)

By calculating the value of pure carbon, limestone or ore by rules IV, XV, XVI upon the bases of the cost of the material used, and the blast furnace labor, etc., expended on them, a contrast will be made indicating the preferable selections.

By rule XVII the safe maximum burden can be readily calculated for any combination of materials used in blast furnaces, enabling the management to apply full burden or duty upon the fuel without experimenting or waiting to see the result by passing certain ores through the furnace, and to keep this full duty upon the fuel during enforced or preferred changes whether of the fuel ores or limestone.

It is believed that furnaces are injured more by light burdening in blowing in or in not coming up to the full burden promptly, than by any and all other causes combined. During a blast one ore may be substituted for another, or one full may be more readily obtained, or obtained at a lower figure than that in use, and hence substituted. It is of the highest importance that the changes in the burdens be made simultaneously with the change in these materials, which will compensate for the difference in composition.

I. To Determine the Efficiency of a Limestone.

From the sum of the lime and magnesia, deduct the sum of the silica and alumina.

Example.—The limestone containing:

CaO	MgO	SiO_2	Al_2O_3
.50	.020	.03	.01

Then $(.50 + .025)-(.03 + .01) = .485$.

II. To Determine the Weight of Limestone Required to Flux the Unit of a Given Ore.

From the sum of the silica and alumina in the ore, deduct the sum of the lime and magnesia, and divide the remainder by the figure representing the efficiency of the limestone.

Example.—The limestone being as in the preceding example, and the ore containing:

Fe	SiO_2	Al_2O_3	CaO	MgO
.55	.103	.026	.028	.019

Then $\frac{(.103 + .026) - (.028 + .019)}{.485} = \frac{.082}{.485} = .17$.

III. To Determine the Weight of Limestone Required for the Unit of a Given Fuel.

From the sum of the silica and the alumina of the ash of the fuel, deduct the sum of the lime and magnesia; divide the remainder by the efficiency of the limestone, and multiply the quotient by the ash of the fuel.

Example.—The fuel containing carbon .85, and ash .11, and the constituents of the ash being:

SiO_2	Al_2O_3	CaO	MgO
.53	.28	.02	.01

Limestone, as before.

Then $(.53 + .28) - (.02 + .01) = .78$; $.78 \div .485 = 1.608$; $1.608 \times .11 = .177$.

IV. To Determine the Weight of Slag Due to the Impurities of a Unit of Limestone.

From the sum of the lime, magnesia, silica and alumina of the limestone, deduct its efficiency, and add 5 per cent. to the remainder.

Example.—Limestone, as before.

Then $(.50 + .025 + .03 + .01) - .485 = .08 + 5$ per cent. $= .0804$.

V. To Determine the Weight of Slag Due to the Impurities of a Fuel per Unit of Fuel.

Multiply the sum of the silica, alumina, lime and magnesia of the ash of the fuel by the percentage of ash. Add to this the sum of the silica, alumina, lime and magnesia per unit of limestone, multiplied by the weight of limestone required for this fuel, and to the sum add 5 per cent.

Example.—Fuel and limestone as before.

Then $(.53 + .28 + .02 + .01) \times .11 + (.50 + .025 + .03 + .01) \times .177 = .1924 + 5$ per cent. $= .202$.

VI. To Determine the Weight of the Slag Due to the Impurities of an Ore and Limestone per Unit of Ore.

To the silica, alumina, lime and magnesia of the ore, add the sum of the same constituents per unit limestone, multiplied by the weight of limestone required, and add 5 per cent.

Example.—Material as above.

Then $(.103 + .026 + .028 + .019) + (.50 + .025 + .03 + .01) \times .17 = .271$ and $.271 + 5$ per cent $= .285$.

VII. To Determine the Weight of the Slag Due to the Impurities of an Ore per Unit of its Iron.

Divide the slag found by Rule VI by the iron in the ore.

Example: $.285 \div .55 = .518$.

VIII. To Determine the Available Carbon of a Fuel.

Multiply the slag due to the impurities (Rule V) by .228 and deduct the product from its per cent. of fixed carbon.

Example: .202 × .228 = .046 ; .85 — .046 = .804.

IX. To Determine the Fuel Required for a Unit of Slag.

Divide .228 by the available carbon of the fuel.

Example: .228 ÷ .804 = .285.

X. To Determine the Fuel Required per Unit of Pig Iron.

Divide .66 by the efficiency of the fuel (Rule VIII).

Example: .66 ÷ .804 = .821.

XI. To Determine the Fuel Required per Unit of Pig Iron from a Given Iron-Ore, Limestone and Fuel.

Add together the slag due to required weights of ore and limestone, and multiply the sum by .228 ; to the product add .6604, and divide the sum by the efficiency of the fuel.

Example.—Materials as above.

Ore required at 55 per cent. = 1.818.
Slag (example given above) 1.818 × .285 = .518.
Limestone .17 × 1.818 = .309 ; 309 × .0804 = .0248.
(.518 + .248) × .228 = .1238.
(.1238 + .6604) ÷ .804 = .975 =the fuel required.

XII. To Determine the Weight of Slag to the Unit of Pig Iron.

Add the weight of slag from limestone, multiplied by the required quantity for both ore and fuel, to the weight of slag from the ore, multiplied by the weight of ore used, and add to the sum the weight of slag from the fuel, multiplied by the weight of the fuel used.

Example.—Materials as above.

Then, .0804 × (.177 × .971 + .17 × .818) = .0386 ; 1.818 × .284 .516 ; .971 × .202 = .196 ; .0386 + .516 + .196 = .750.

XIII. The Manufacturing Cost of Pig Iron having been A Dollars, and the Weight of the Slag to the Unit of Pig-Iron having been B; to Determine the Manufacturing Cost per Unit of Slag and Unit of Iron.

Multiply B by .45 and add 1; divide this sum into cost A, and the quotient will be the cost per ton of pig. Deduct this cost of the pig from the total A, and the remainder will be the cost of the slag. Divide this cost by the weight of the slag and the quotient will be the cost per unit of the slag.

Example.—Manufacturing cost from last year's operations, $3.00 per ton of pig iron ; weight of slag .750 to 1 of pig iron.

Then .750 × .45 + 1 = 1.337 ; $\frac{3}{1.337}$ = $2.24 = cost of pig less the cost of the slag.
$3.00 — $2.24 = 76 cents, cost of slag per ton of pig.
$76 ÷ 75 = $1.01, cost per ton of slag.

The foregoing materials are taken at the following prices, viz:

Fuel, $4.00 per ton.
Limestone, $1.25 per ton.
Ore, $3.00 per ton.

XIV. To Determine the Value of Pure Carbon from the Cost of the Fuel and the Cost Incurred by its Impurities.

Divide the price of the fuel by its available carbon, $4.00 ÷ .804, ...	= $4.975
Add the cost of the limestone required .177 ÷ .804 × $1.25, ...	= .275
Add the manufacturing cost of the slag for the fuel and limestone per unit of available carbon .202 × 1.01 ÷ .804, ...	= .254
	$5.504

XV. To Determine the Value of the Pure Lime from the Cost of the Limestone and the Cost Incurred by its Impurities.

Divide the cost of the limestone by its efficiency, $1.25 ÷ .485, ...	= $2.577
Add the cost of the carbon required by its impurities (.0804 × .228) ÷ (.485 × 5.504), .	.208
Add the manufacturing cost per unit of efficiency .0804 × $1.01 ÷ .485, ...	.165
	$2.950

XVI. To Determine the Value of Pure Oxide of Iron from the Cost of an Ore and the Cost Incurred by its Impurities.

Divide the price of the ore by the percentage of its oxide of iron ($3.00 ÷ .55) ÷ $\frac{10}{7}$, ...	= $3.818
Add the value of the carbon required by the impurities of the ore per unit of oxide .271 ÷ .785 × .228 × $5.504, ...	= .433
Add cost of lime required per unit of the oxide .0858 ÷ .785 × $2.95, ...	= .315
Add manufacturing cost for the slag per unit of the oxide .271 ÷ .785 × $1.01, ...	= .348
	$4.914

VERIFICATION OF THE ABOVE CALCULATIONS.

Cost of the Pig, Using the Calculated Values for the Pure Materials.

$\frac{10}{7}$ tons of oxide of iron, at $4.914, ...	= $7.02
.6604 tons of carbon, at $5.04, ...	= 3.36
Manufacturing cost, ...	= 2.24
	$12.92

Cost Calculated the Usual Way:

1.818 tons of ore, at $3.00, ...	= $5.454
.975 tons of fuel, at $4.00, ...	= 3.900
.48 tons limestone, at $1.25, ...	= .600
Manufacturing cost, ...	= 3.000
	$12.954
Difference, ...	= $.034

XVII. To Determine the Proper Burden of an Iron Ore and Limestone to the Unit of Fuel.

Determine the fuel required per unit of pig iron by Rule XI, divide the weight of the ore per unit of pig iron by the result, and the dividend will be the ore burden per unit of fuel.

To Determine the Limestone.—Multiply the weight of ore charged per unit of by the per cent. of limestone given by Rule II, and add to the per cent. of limestone required for the fuel by Rule III, the sum will be the limestone to be charged per unit of fuel.

Ore, 1.818.
Fuel, .975.
1.818 ÷ .975—1.863.

Limestone required for this ore (Rule II) 1.863 × .17 =	.317
Limestone required for the fuel (Rule XIII),	.177
	.494

Burden—For every pound of fuel charge 1.863 of ore and .494 of stone.

LEESPORT IRON COMPANY.

Leesport, Pa., November 7, 1892.

PHILADELPHIA ENGINEERING WORKS, Ltd.,
Philadelphia, Pa.

GENTLEMEN: In answer to your inquiry in regard to the success of the two Gordon-Whitwell-Cowper Fire-Brick Hot Blast Stoves, 18 x 60 feet, erected by you for the Leesport Iron Company, Limited, in 1890, would say that they have been a success in every way. They are easily handled, easily cleaned and quickly changed from blast to gas, and vice-versa. Have given us an even temperature. No trouble to keep blast hot with small amount of gas. In fact, have had no trouble with them.

Yours respectfully,
LEESPORT IRON COMPANY,
Per Jno. C. Wiley, Supt.

JUNCTION IRON COMPANY.

Mingo Junction, O., October 29, 1892.

PHILADELPHIA ENGINEERING WORKS, Ltd.,
Philadelphia, Pa.

GENTLEMEN: We beg to advise that we are using the four Fire-Brick Stoves erected for us by Messrs. Gordon, Strobel & Laureau, and find that we can heat 21,000 cubic feet of air per minute to 1350 degrees, without difficulty Would also say since the plant has been in operation have had but very little expense for maintenance or cleaning.

Very truly yours,
H. M. PRIEST, Prest.,
Junction Iron Company.

SOUTHERN IRON COMPANY,

Nashville, Tenn., November 1, 1892.

FRED. W. GORDON, Chairman,
Philadelphia, Pa

DEAR SIR: The Tennessee Coal, Iron and Railroad Company, and the Southern Iron Company have been using your improved Fire-Brick Stoves for more than four years. The best evidence of the fact that they have given satisfaction is that we are now preparing to replace some of our old stoves with your improved stoves.

Yours truly,
A. M. SHOOK,
Prest. and Genl. Mgr.,
Southern Iron Company.

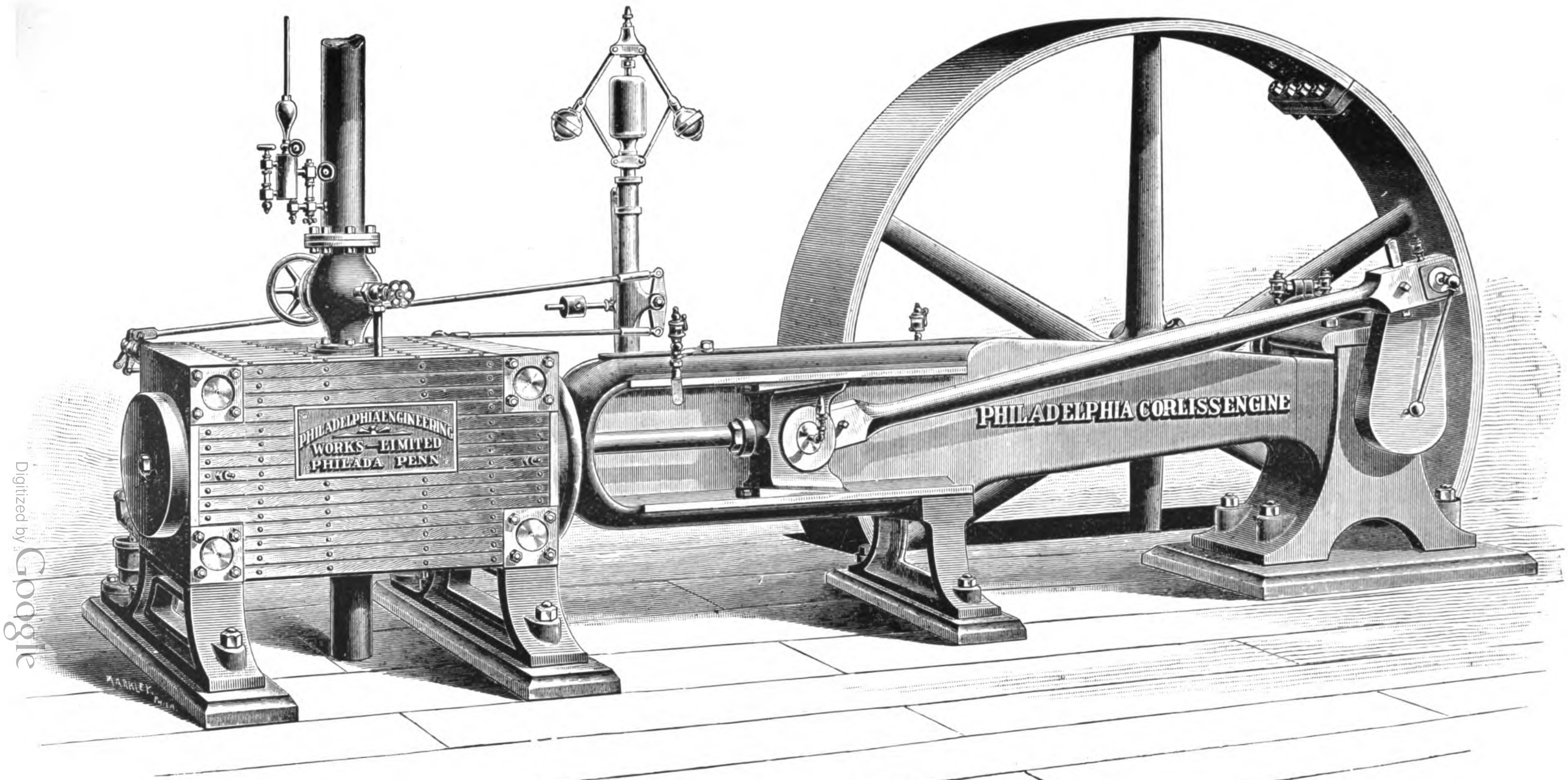
TOPTON FURNACE COMPANY.

Topton, Pa., October 31, 1892.

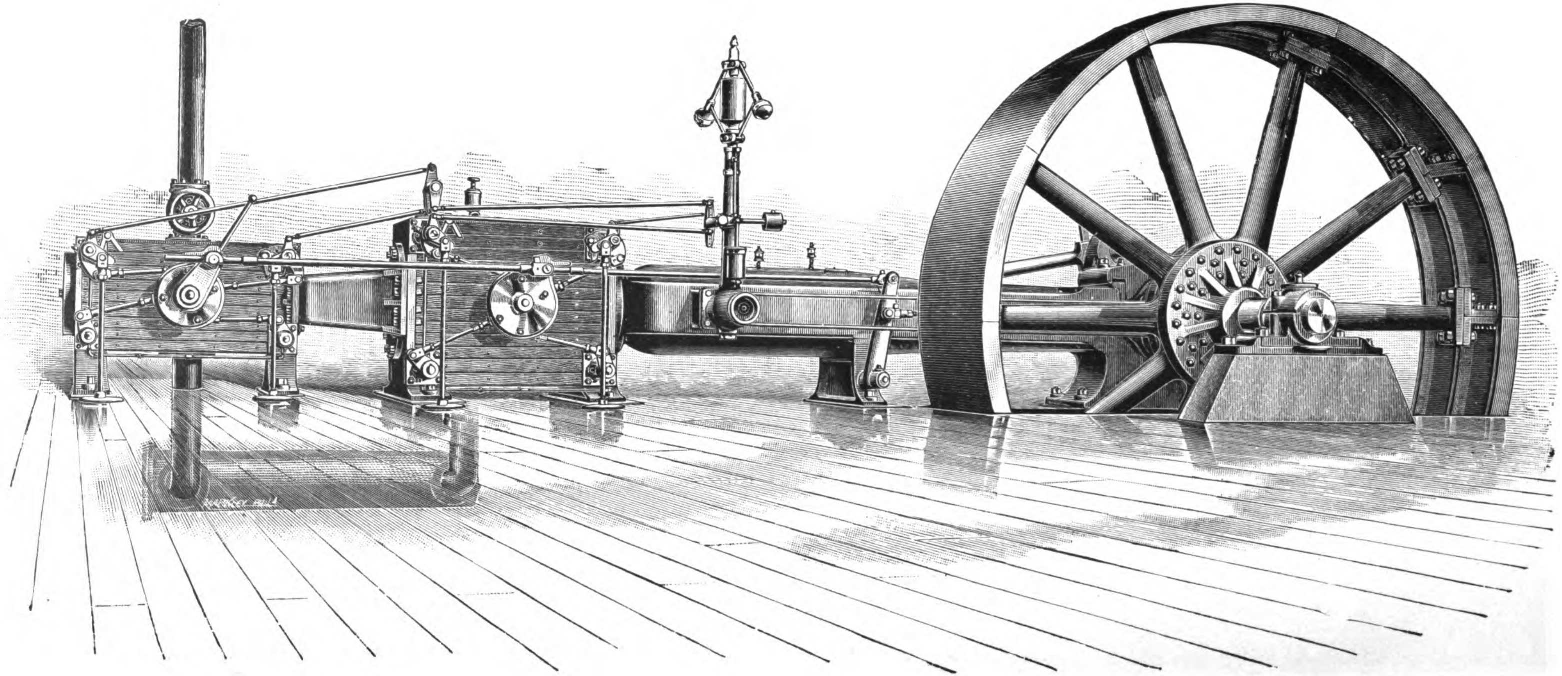
PHILADELPHIA ENGINEERING WORKS, Ltd.

GENTLEMEN: Since the erection of your Fire-Brick Stoves we have been doing most excellent work with this furnace. We have increased our output about 35 per cent. and reduced our fuel consumption about 6 cwt. to the ton of pig iron, with most excellent results on foundry iron over former work with iron pipe stoves. Have no trouble in operating them, and are highly pleased with the plant.

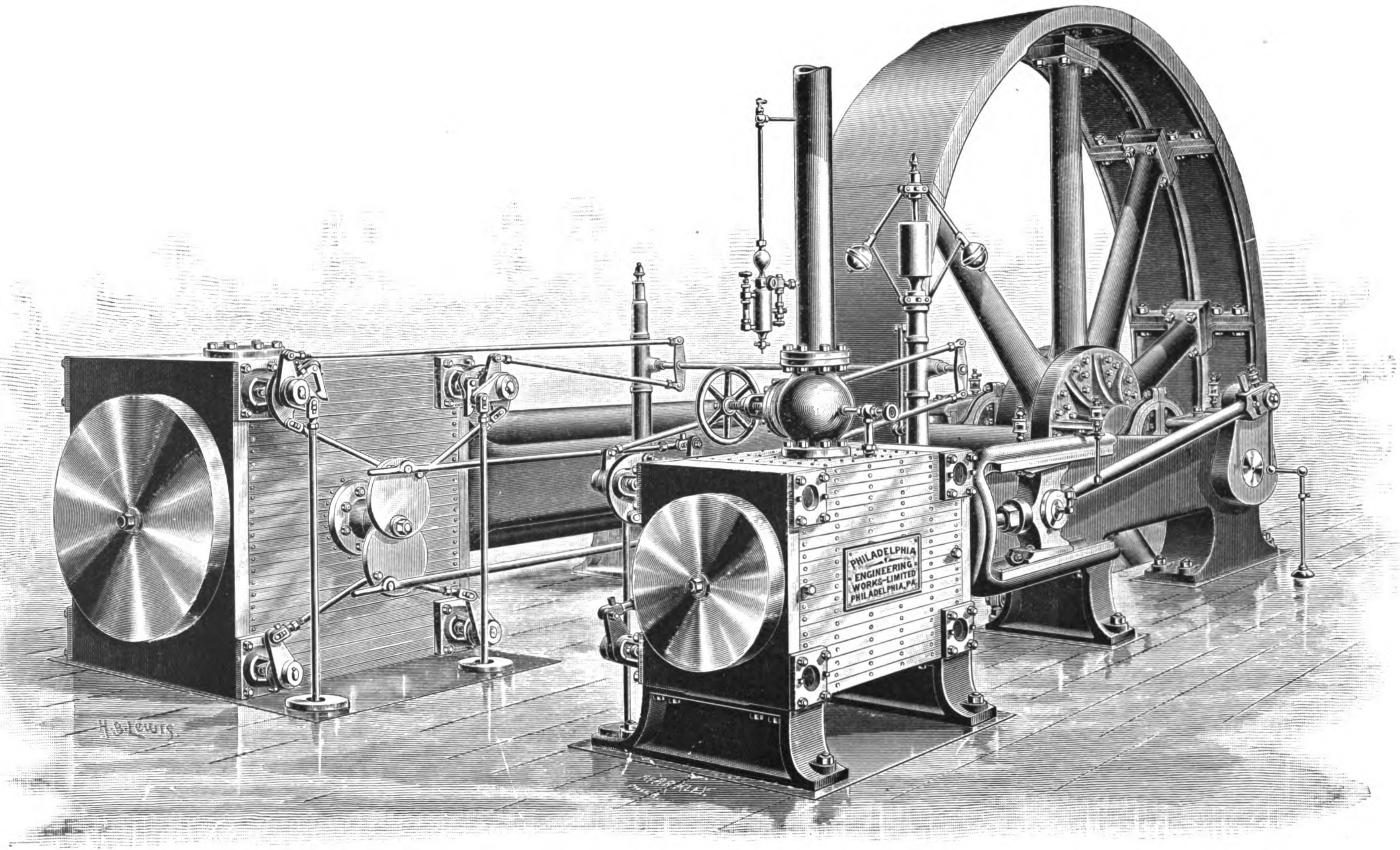
Yours truly,
ISAAC ECKERT, Treas.,
Topton Furnace Company.



PHILADELPHIA CORLISS ENGINE.



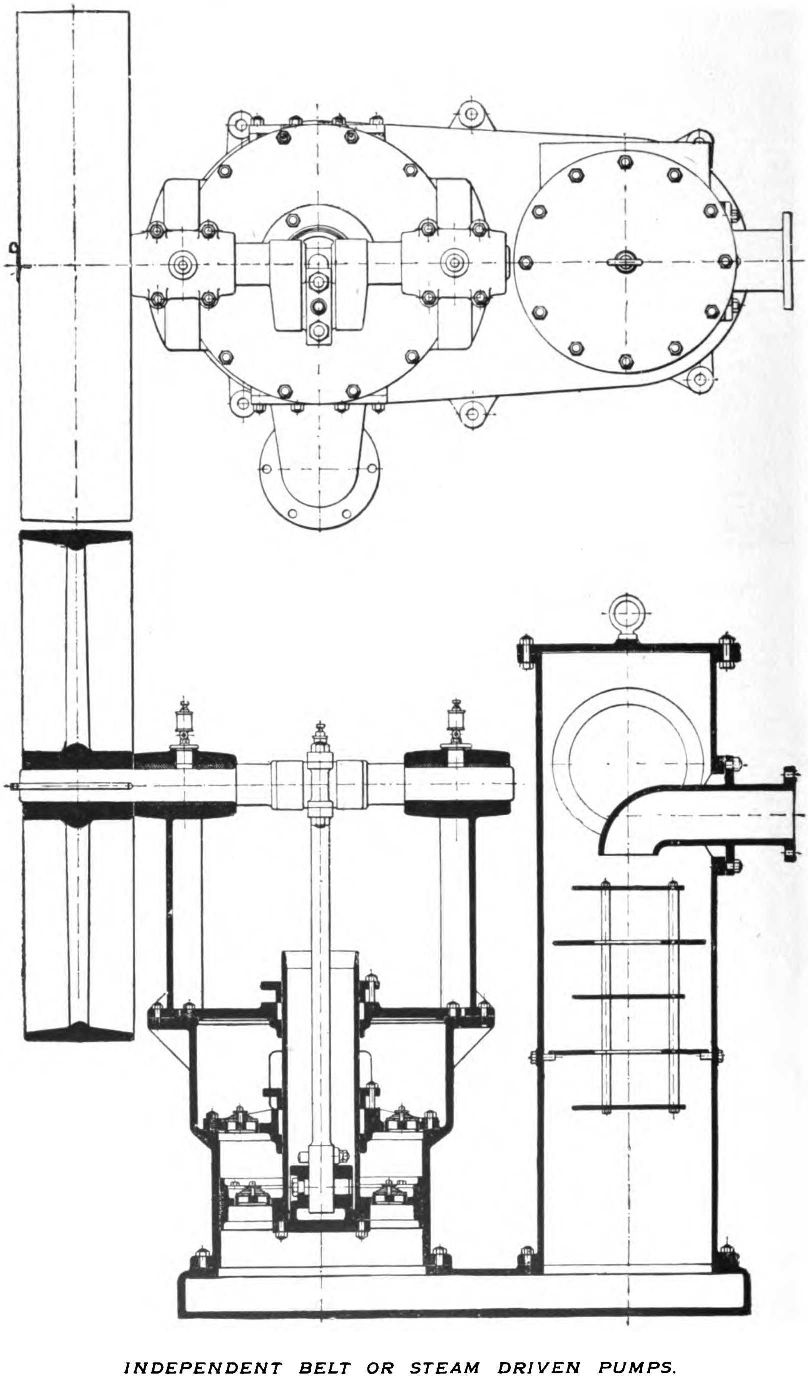
Tandem Compound Condensing Philadelphia Corliss Engine.



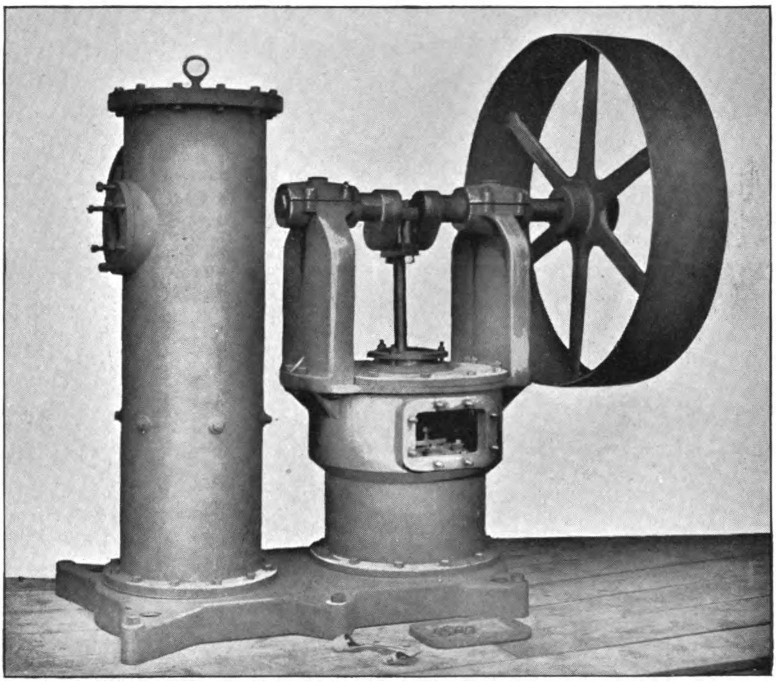
CROSS COMPOUND CONDENSING PHILADELPHIA CORLISS ENGINE.

BUILT BY PHILADELPHIA ENGINEERING WORKS, LIMITED, PHILADELPHIA, PA.

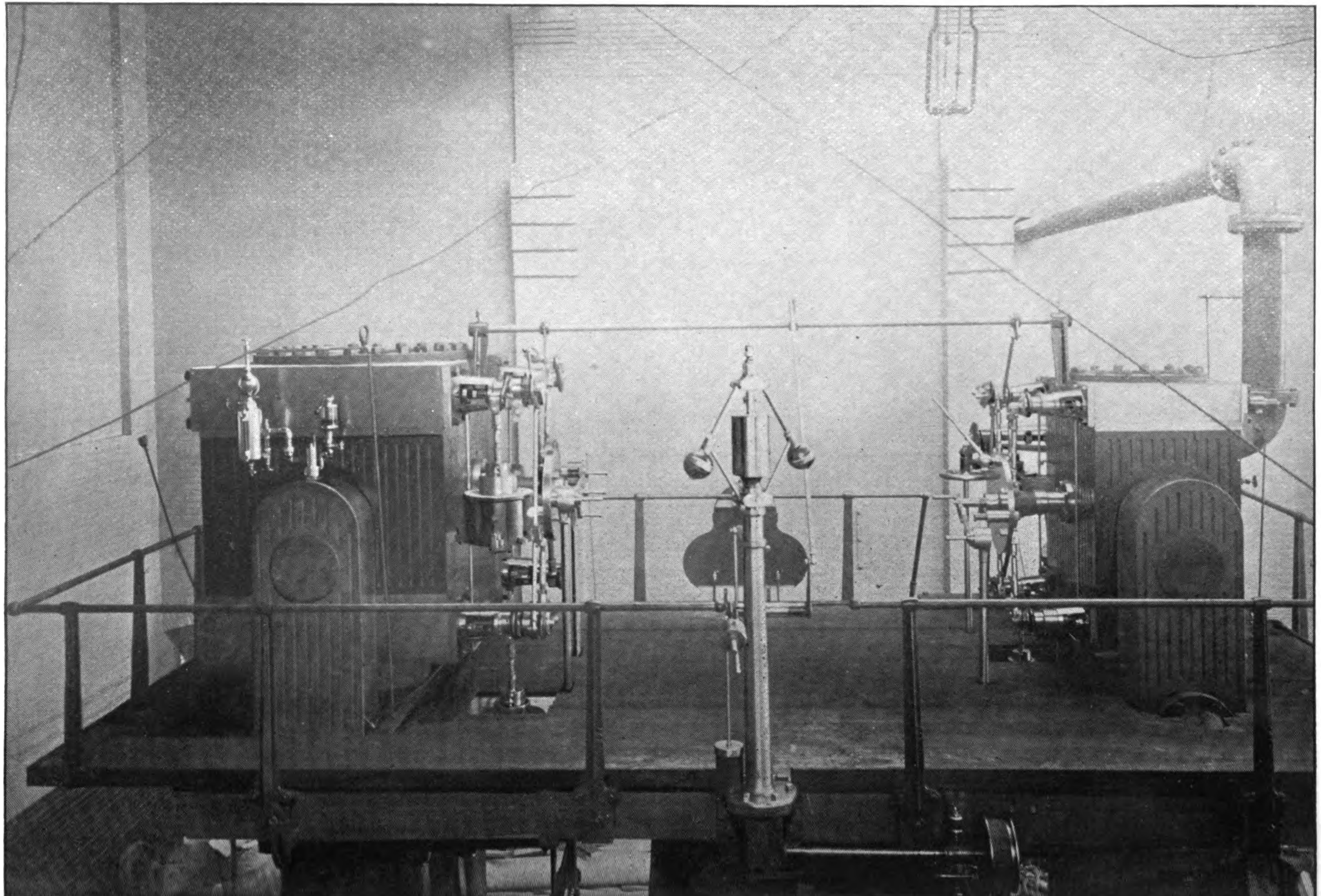
AIR PUMP AND CONDENSERS.



INDEPENDENT BELT OR STEAM DRIVEN PUMPS.



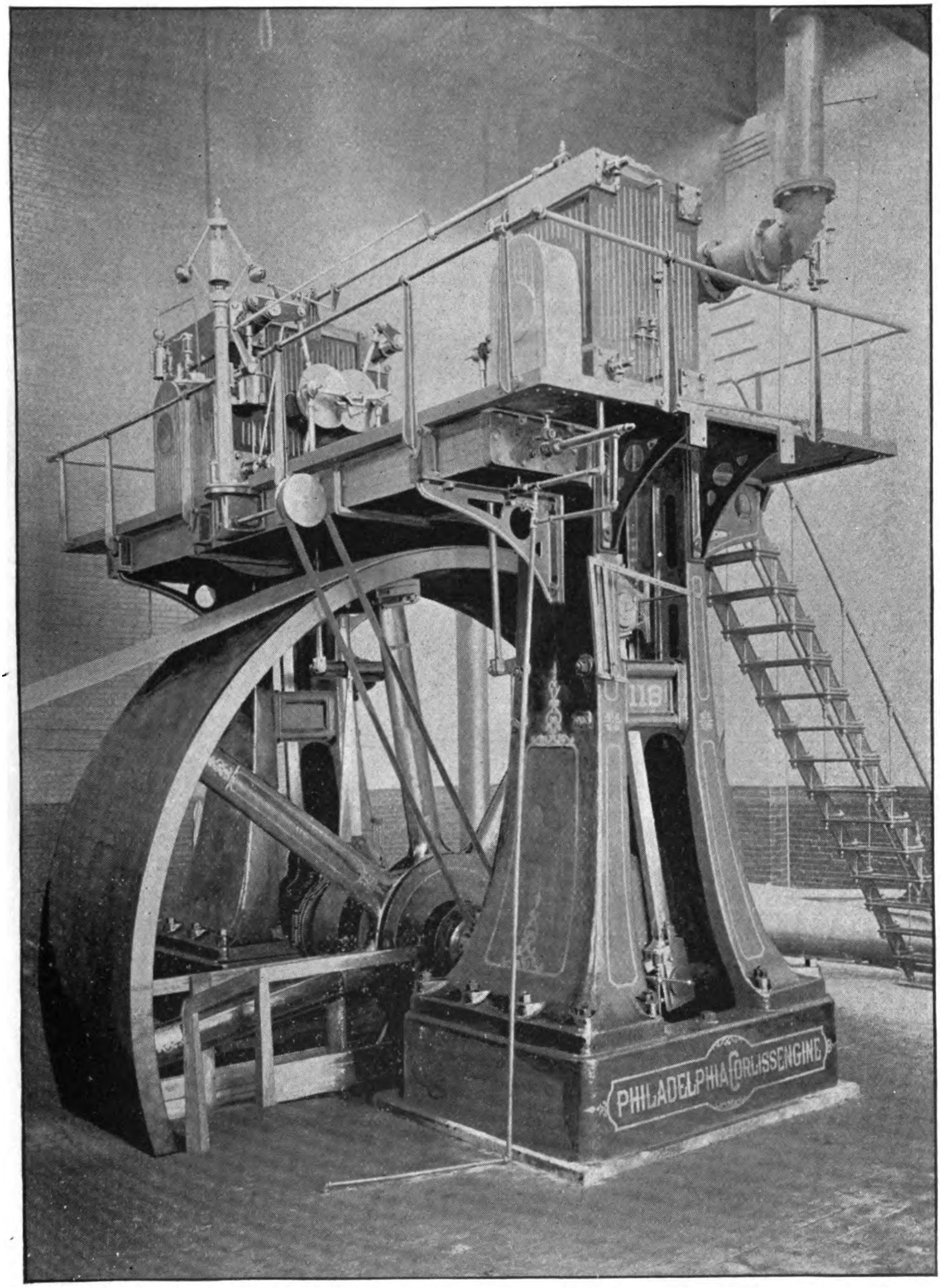
AIR PUMP AND JET CONDENSER.



VIEW LOOKING DOWN ON PLATFORM.

HIGH SPEED COMPOUND CONDENSING CORLISS STEAM ENGINE.

CYLINDERS, 20 & 30 INCHES IN DIAMETER. STROKE, 36 INCHES. REVOLUTIONS, 100 PER MINUTE.

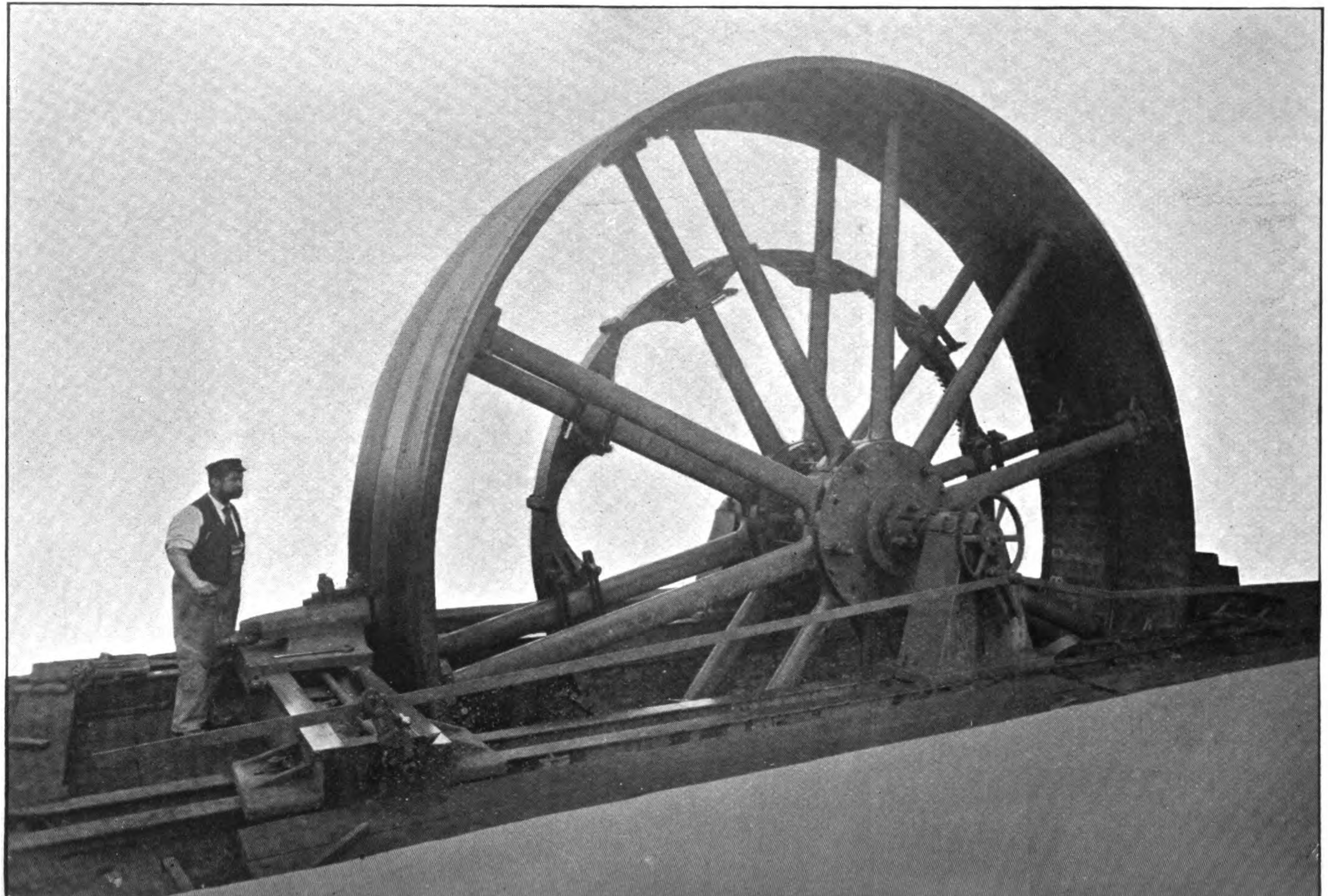


BUILT FOR

HUDSON ELECTRIC LIGHT AND POWER CO., 14TH ST., HOBOKEN, N. J.

Band and Fly Wheel for Engines of Any Type.

MADE IN SIZES FROM 8 FEET TO 35 FEET IN DIAMETER AND ANY FACE UP TO 78 INCHES.



ORE.

Date.					
Location of Mine.					
Name of Ore.					
Iron Oxides,					
Silica,					
Alumina,					
Lime Carbonate,					
Magnesia Carbonate,					
Sulphur,					
Phosphoric Acid,					
Oxide of Manganese,					
Copper,					
Titanic Acid,					
Water,					
Metallic Iron,					
Sulphur,					
Phosphorus,					
Chemist or Laboratory,					

ORE.

Date,						
Location of Mine,						
Name of Ore,						
Iron Oxides,						
Silica,						
Alumina,						
Lime Carbonate,						
Magnesia Carbonate,						
Sulphur,						
Phosphoric Acid,						
Oxide of Manganese,						
Copper,						
Titanic Acid,						
Water,						
Metallic Iron,						
Sulphur,						
Phosphorus,						
Chemist or Laboratory,						

ORE.

Date, Location of Mine, Name of Ore,						
Iron Oxides, Silica, Alumina, Lime Carbonate, Magnesia Carbonate, Sulphur, Phosphoric Acid, Oxide of Manganese, Copper, Titanic Acid, Water,						
Metallic Iron, Sulphur, Phosphorus,						
Chemist or Laboratory,						

ORE.

Date,						
Location of Mine,						
Name of Ore,						
Iron Oxides,						
Silica,						
Alumina,						
Lime Carbonate,						
Magnesia Carbonate,						
Sulphur,						
Phosphoric Acid,						
Oxide of Manganese,						
Copper,						
Titanic Acid,						
Water,						
Metallic Iron,						
Sulphur,						
Phosphorus,						
Chemist or Laboratory.						

LIMESTONE.

Date,						
Location of Quarry,						
Name,						
Lime Carbonate.						
Magnesia Carbonate,						
Silica,						
Alumina,						
Calcic Sulphide,						
Maganese,						
Iron Oxides,						
Phosphoric Acid,						
Water,						
Chemist or Laboratory,						

LIMESTONE.

Date,						
Location of Quarry,						
Name,						
Lime Carbonate,						
Magnesia Carbonate,						
Silica,						
Alumina,						
Calcic Sulphide,						
Maganese,						
Iron Oxides,						
Phosphoric Acid,						
Water,						
Chemist or Laboratory						

LIMESTONE.

Date,						
Location of Quarry,						
Name,						
Lime Carbonate.						
Magnesia Carbonate,						
Silica,						
Alumina,						
Calcic Sulphide,						
Maganese,						
Iron Oxides,						
Phosphoric Acid,						
Water,						
Chemist or Laboratory						

LIMESTONE.

Date,						
Location of Quarry,						
Name,						
Lime Carbonate,						
Magnesia Carbonate,						
Silica,						
Alumina,						
Calcic Sulphide,						
Maganese,						
Iron Oxides,						
Phosphoric Acid,						
Water,						
Chemist or Laboratory						

PIG IRON.

Date,					
Furnace,					
Ores used,					
Fuel,					
Strength,					
Color,					
Grade,					
Metallic Iron,					
Comb. Carbon,					
Graphitic Carbon,					
Silicon,					
Sulphur,					
Phosphorus,					
Chemist or Laboratory,					

PIG IRON.

Date,						
Furnace,						
Ores used,						
Fuel,						
Strength,						
Color,						
Grade,						
Metallic Iron,						
Comb. Carbon,						
Graphitic Carbon,						
Silicon,						
Sulphur,						
Phosphorus,						
Chemist or Laboratory						

PIG IRON.

Date,						
Furnace,						
Ores used,						
Fuel,						
Strength,						
Color,						
Grade,						
Metallic Iron,						
Comb. Carbon,						
Graphitic Carbon,						
Silicon,						
Sulphur,						
Phosphorus,						
Chemist or Laboratory,						

PIG IRON.

Date,						
Furnace,						
Ores used,						
Fuel,						
Strength,						
Color,						
Grade,						
Metallic Iron,						
Comb. Carbon,						
Graphitic Carbon,						
Silicon,						
Sulphur,						
Phosphorus,						
Chemist or Laboratory						

PHILADELPHIA ENGINEERING WORKS, LIMITED.

FUEL.

Date,					
Name of material,					
Location of Mine,					
Fixed Carbon.					
Ash,					
Sulphur,					
Phosphorus,					
Vol' Combustible,					
Water,					
Analysis of the Ash,					
Silica,					
Alumina,					
Lime,					
Magnesia,					
Iron Oxides,					
Chemist or Laborat					

FUEL.

Date, Name of material, Location of Mine,						
Fixed Carbon, Ash, Sulphur, Phosphorus, Vol' Combustible, Water,						
Analysis of the Ash Silica, Alumina, Lime, Magnesia, Iron Oxides, Chemist or						

FUEL.

Date,					
Name of material,					
Location of Mine,					
Fixed Carbon,					
Ash,					
Sulphur,					
Phosphorus,					
Vol' Combustible,					
Water,					
Analysis of the Ash,					
Silica,					
Alumina,					
Lime,					
Magnesia,					
Iron Oxides,					
Chemist or Laboratory,					

FUEL.

Date,						
Name of material,						
Location of Mine,						
Fixed Carbon,						
Ash,						
Sulphur,						
Phosphorus,						
Vol' Combustible,						
Water,						
Analysis of the Ash						
Silica,						
Alumina,						
Lime,						
Magnesia,						
Iron Oxides,						
Chemist or Laboratory						

SLAG.

Date,					
Furnace,					
Ores used,					
No. of Iron,					
Lime,					
Magnesia,					
Silica,					
Alumina,					
Oxide of Iron					
Calcic Sulphide,					
Manganese,					
Chemist or Laboratory					

SLAG.

Date,						
Furnace,						
Ores used,						
No. of Iron,						
Lime,						
Magnesia,						
Silica,						
Alumina,						
Oxide of Iron,						
Calcic Sulphide,						
Manganese,						
Chemist or Laboratory						

SLAG.

Date,						
Furnace,						
Ores used,						
No. of Iron,						
Lime,						
Magnesia,						
Silica,						
Alumina,						
Oxide of Iron						
Calcic Sulphide,						
Manganese,						
Chemist or Laboratory						

SLAG.

Date,					
Furnace,					
Ores used,					
No. of Iron,					
Lime,					
Magnesia,					
Silica,					
Alumina,					
Oxide of Iron,					
Calcic Sulphide,					
Manganese,					
Chemist or Laboratory					